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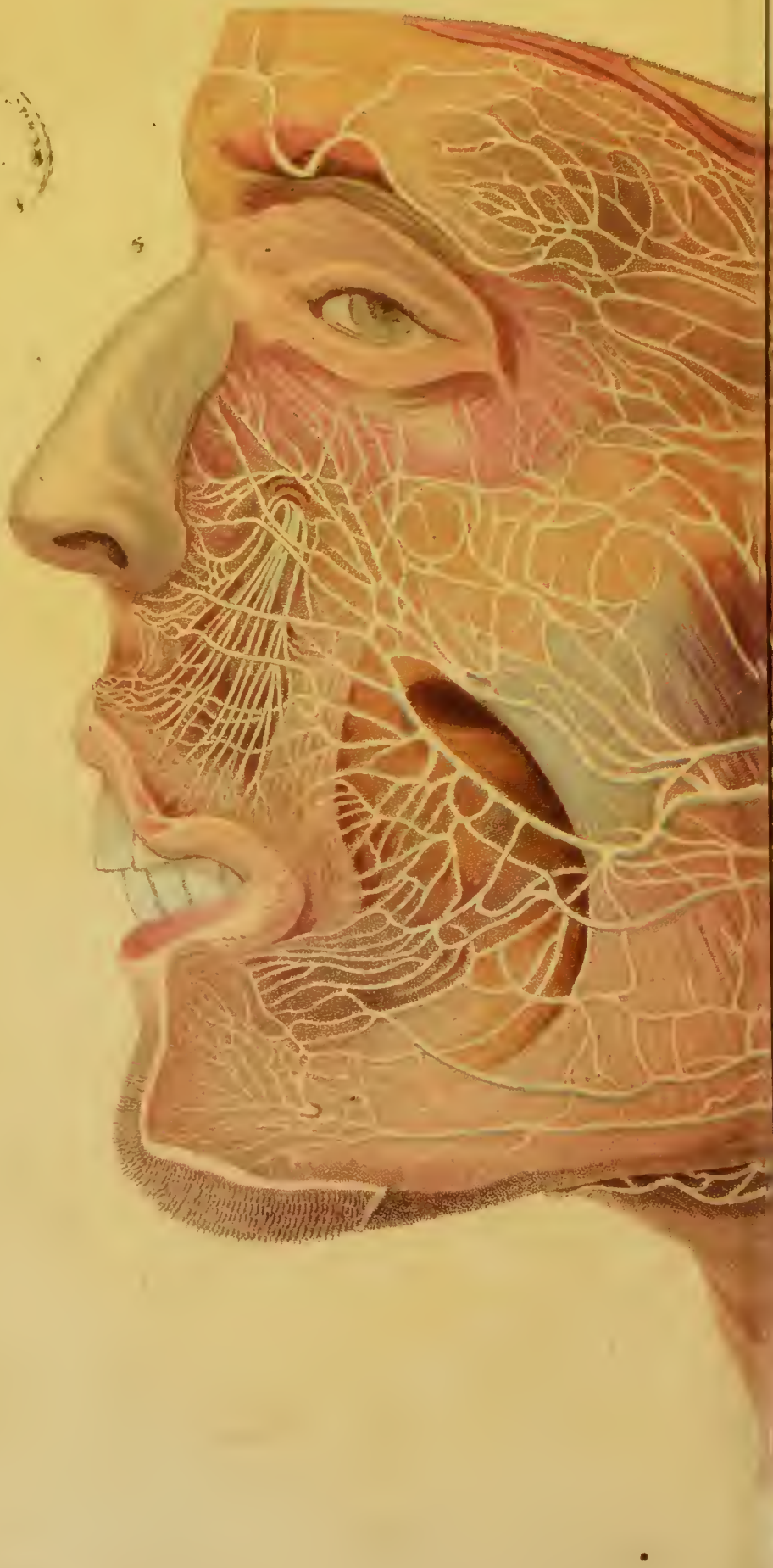
A

DISSERTATION,

&c. &c.



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A

DISSERTATION

ON THE

TREATMENT

OF

MORBID LOCAL AFFECTIONS OF NERVES:

TO WHICH

The Jacksonian Prize

WAS ADJUDGED BY

THE ROYAL COLLEGE OF SURGEONS.

BY JOSEPH SWAN,

MEMBER OF THE ROYAL COLLEGE OF SURGEONS, AND SURGEON TO THE LINCOLN COUNTY HOSPITAL.

"Non scribo hoc temere. Quo minus familiaris sum, hoc sum ad investigandum curiosior." CIC. EP. AD FAM. Lib. iv. Ep. xiii.

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TO

THE ROYAL COLLEGE OF SURGEONS,

THE FOLLOWING DISSERTATION,

HONOURED WITH THE

JACKSONIAN PRIZE OF THE PRESENT YEAR,

AND PUBLISHED FOR

THE PROMOTION OF CHIRURGICAL KNOWLEDGE,

IS, BY PERMISSION,

MOST RESPECTFULLY INSCRIBED

BY

THEIR VERY FAITHFUL,

AND OBEDIENT, HUMBLE SERVANT,

JOSEPH SWAN.

PREFACE.

THE anatomy of the nervous system has been prosecuted by so many and such able men, and with such an apparent degree of success, that it cannot be a matter of wonder if nothing materially new is brought forward in attempting to make a minute dissection; but though so much attention has been given to it by many learned men, and nearly as much knowledge of it as of any other part of the human body is contained in books of anatomy, yet its physiology has hitherto remained in almost total obscurity.

From repeated observations we ascertain the effects of the nervous influence; but of its nature, and of the manner in which it acts to produce these effects, we have little or no knowledge.

Of all the theories that have been invented, none certainly appears so rational as that of electricity; and it seems the more plausible from this circumstance, that the Galvanic influence on the nerves of an animal apparently dead, will produce the same motions in the parts to which these nerves are distributed, that were produced in them when the animal was alive.

The fact of the torpedo and gymnotus electricus being able to give shocks exactly like those produced by electricity, and their being provided with a particular apparatus, which is supplied with large nerves entirely for this particular purpose, leads still further to the presumption, that

the nervous influence is very much like electricity, if not the same thing.

We know that when a part has been deprived of the nervous influence, by its communication with the sensorium being intercepted, the functions of the part to which the nerve is distributed are suspended, and are incapable of being reproduced until the divided portions of nerve have become reunited, except through electricity; but beyond this we know little. And such being the imperfect state of our knowledge in the sound state of the nerves, it is not to be wondered at if our reasoning respecting their diseases is very limited and fallacious.

The less frequent occurrence of diseases of the nerves, compared with those that happen to other parts, makes it a subject more difficult to treat of; and this difficulty has caused many writers on me-

dicine and surgery either to pass over it entirely, or if they have been induced to advert to it at all, not to give it that particular and accurate consideration which its importance well deserves.

The reason why every thing at present relating to the diseases of nerves is so very uncertain, and our best method of practice in those cases so very undetermined, is, because our knowledge respecting the changes the nervous system undergoes in injuries and diseases, is in a great measure theoretical.

For though the anatomy of this system, as I have already observed, has engaged the attention of many men of the highest ability in the profession, and is well exhibited in books, it is only when it comes to be more generally cultivated, and more frequent and more accurate experiments have been made, that our practice will then be

founded on the certain laws that always exist in the animal economy ; and then, and not till then, we may expect to arrive at a more satisfactory degree of knowledge to guide us to an improved mode of treating its injuries and diseases.

By the same Author,

An ACCOUNT of a NEW METHOD of MAKING DRIED ANATOMICAL PREPARATIONS; exhibiting the various structures of Animal Bodies, so as to present the same appearances as a fresh subject when first dissected; and by preventing every offensive smell, and the usual destructive effects of heat, damp, and insects, affording the opportunity of keeping them unaltered for any number of years: and as putrefaction can be stopped by the same process, enabling the anatomist to dissect a putrid body, in any place, and at any season of the year, without the least inconvenience. Second edition, considerably enlarged.

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ERRATA.

Page 67, line 16, *for* ' nucrilema,' *read* ' neurilema.'
Page 144, note, *for* ' Nisographie,' *read* ' Nosographie.'
Page 183, line 9, *for* ' from,' *read* ' form.

A

DISSERTATION,

&c.

OF DISEASES AND INJURIES OF NERVES IN GENERAL.

Injuries and diseases of the various parts of the nervous system are attended with such different symptoms, that I shall consider them under two distinct heads; viz. those that affect the nerves belonging to the senses, and those that affect such nerves as are under the influence of the will. A third division might be added, which would include the Ganglian system, belonging chiefly to the grand sympathetic nerve, and distributed in great measure to the thoracic and abdominal viscera; but as I do not know that any particular researches have been made by Pathologists into this part

of the nervous system, to ascertain whether disease occasions any change in it to take place in the parts to which it is distributed, and as it is not much connected with the department of the surgeon, I shall pass it over, for as I could say very little more than what is theoretical, it would not answer the intention for which the present subject was proposed.

OF DISEASES AND INJURIES OF THE NERVES OF THE SENSES.

None of the senses except that of touch seem to suffer much from injuries and diseases, or at least they do not excite so much constitutional disturbance as affections in other parts of the nervous system do; when, however, they have once become affected, they seem less liable to undergo the restorative process than the other nerves, at least as far as regards their proper functions in producing their particular senses.

OF DISEASES AND INJURIES OF THE OLFACTORY NERVES.

The power of the nerves constituting the sense of smell, may be diminished or destroyed

by the frequent application of strong odours to the nose, or from an inflammation of the Schneiderian membrane. The same thing may likewise happen from pressure on the origins of the nerves by hydatids, or an accumulation of water in the lateral ventricles of the brain, or from their being involved in a diseased action going on at the under surface of the anterior lobes of the brain, or from a diminution of the foramina of the cribriform plate of the ethmoid bone. When there is an inflammation of the Schneiderian membrane, which takes away this sense, leeches may be applied to the outside of the nose; and the inside may be anointed by means of a feather with some cooling ointment, and purging medicines may be given. All the other diseases are generally beyond the reach of art.

In the following case the sense of smell of the right nostril appeared to have been suspended by an inflammatory action going on about the crista galli.

Case 1.

J. S. about 30 years of age, had complained of a very violent pain in the forehead for many days, especially towards the right side of the

crista galli of the ethmoid bone, as far as I could understand from the description he gave of his complaints. He entirely lost the sense of smell of the right nostril, but that of the left remained perfect. He was bled copiously from the arm and from the temples with leeches, and he took antimonial powder, with submuriate of mercury and sulphate of magnesia, and was put on a strict antiphlogistic regimen. By these means the pain kept gradually wearing away, and the sense of smell returned.

In a similar case related by Morgagni, which terminated fatally, there were evident marks of an inflammatory action having subsisted, for he says, " On opening the head nothing unnatural was found, except at the anterior part of the brain, when on the left side some quantity of blood was effused, but on the right, towards the crista galli, the brain itself was hard and callous, and very firmly connected with the dura mater *."

The functions of the olfactory nerves are sometimes so diseased as to produce a sense of unpleasant odours. In some cases this is owing to ulcers, &c. about the nose and throat,

* Morgagni de Causis et Sedibus Morborum. Epist. ix. cap. 25.

but frequently there is neither a disease in the nose, or neighbouring parts, that can account for it. We know that when morbid impressions are made on the optic nerve, spots of various shapes and colours are seen, as though they were really what they appear to be. Also when the auditory nerve is morbidly affected, various sorts of noises are complained of by the patient when he is in the stillest place; and may not this perception of unpleasant odours be likewise occasioned by a morbid action of the olfactory nerves? When this is the case, the functions of the stomach and viscera connected with it are frequently deranged, and if these are restored to a healthy state, the disorder will generally cease.

OF DISEASES AND INJURIES OF THE OPTIC NERVE.

Diseases and injuries of this nerve, and its expansion the retina, are almost always attended with a destruction of its functions; so that, though every other tunic of the eye and its humours are perfectly sound, and capable of transmitting freely the rays of light, no impression is made by them on the retina, which constitutes the disease termed amaurosis.

Amaurosis generally comes on with a gra-

dually increasing dimness of sight, and very often with a sensation as if specks of different shapes and colours were floating before the eyes. In many cases there is more or less pain in the head.

Generally the pupils are dilated, but if only one eye is affected, it retains the sympathetic power of contracting and dilating with the sound eye, so that it is necessary to keep the sound eye shut when the diseased one is examined; sometimes, however, the pupil is contracted and irregular. When the disease is coming on, many complain of a great sensibility of the eye, and an intolerance of much light. In this state a slow inflammatory action is going forward in the retina, and if its progress is uninterrupted, the retina becomes gradually more insensible of light, until its perception is quite lost. Sometimes the disease comes on suddenly, or it may be produced by a blow on the eye itself, or on the eye-brow, or below the lower eye-lid. It may be caused too by syphilitic inflammation, and by a too sudden exposure of the eye to an intense light.

It is sometimes owing to a disease of the retina, and sometimes of the optic nerve itself, but the latter has frequently, on dissection,

exhibited no appearance of disease. Sometimes it is caused by water in the ventricles of the brain, or a tumour pressing on the origin of the nerves. Sometimes the nerves have been injured by a disease altering the foramina, through which they pass from the cranium. Morgagni relates cases where the retina has been found forming an osseous lamella, and the optic nerve has been wasted, and shewn more the appearance of an artery than a nerve.

When this disease is the consequence of a blow on the eye, or eye-brow, it is almost always incurable, and also when it is the effect of an organic disease of the retina: in this latter case, instead of the eye looking black through the pupil, it has a pearly appearance, which is sometimes inclining to green. When it is connected with cataracts it is always incurable, and also when the humours are cloudy, and the the pupil is contracted and irregular and will not dilate.

When the disease is coming on, if there are flushings of the cheeks, or other symptoms of a determination of blood to the head, blood ought to be taken from the arm, a blister should be applied to the back of the neck, some leeches to the temples, and mercurial

purges should be given; and when the inflammatory symptoms are gone off, five grains of the blue pill should be given every night for a length of time, and at the same time a strict antiphlogistic regimen should be enforced.

When it comes on with a disorder of the digestive organs, remedies must be used to restore them to their proper functions. If pain in the head is much complained of, and the patient is much debilitated, some blood may be taken from the back of the neck by cupping, or by the application of leeches to the temples, and then blisters may be applied to these parts. If there are no marks of an inflammatory action in the constitution, but, on the contrary, it is much debilitated, tonic medicines should be given. The vapour of æther, or the liquor ammoniæ, may be applied to the eye, and if these remedies do not succeed, electricity should be tried.

Snuff, composed of a quarter of a grain of the hydrargyrus vitriolatus, mixed with four grains of sugar, and snuffed up the nose night and morning, has been supposed to be of use *.

* Observations on the Cataract and Gutta Serena by James Ware.

OF DISEASES AND INJURIES OF THE GUSTATORY NERVES.

The gustatory nerves are sometimes injured by being violently bruised between the teeth, and though there is no apparent injury of the tongue, those powers of the nerve producing the sense of taste will be destroyed, as in the following case related by Sir Everard Home in the Philosophical Transactions.

"A gentleman, by an accident which it is unnecessary to describe, had his tongue bitten with great violence. The immediate effect of the injury was great local pain, but it was not attended with much swelling of the tongue, nor any other symptom, except that the point of the tongue entirely lost its sensibility, which deprived it of the power of taste.

"Whatever substance the patient ate was equally insipid. This alarmed him very much, and induced him to state to me the circumstances of his case, and request my opinion. I examined the tongue a fortnight after the accident, it had the natural appearance, but the tip was completely insensible, and was like a piece of board in his mouth, rendering the act of eating a very unpleasant operation. I saw

him three months afterwards, and it was then nearly in the same state."

The gustatory nerves are disordered in their functions, when things that are at other times sapid make no impression on the tongue, or a very different one from what they are accustomed to do; or, again, when various unpleasant tastes are continually in the mouth. All these affections are generally symptomatic of a disordered state of the stomach, which must be corrected in order to restore the proper functions of the gustatory nerves.

OF DISEASES AND INJURIES OF THE AUDITORY NERVES.

In the following case I had every reason to suppose that the base of the skull was fractured, that the petrous portion of the left temporal bone was very much injured, and that the portio mollis of the seventh pair of nerves was destroyed, or so much injured as to be incapable of performing its functions, as the patient never heard again with that ear.

Case 2.

A man fell from a loaded waggon, and pitched on his head on the left parietal bone. A small wound was made, but this bone was

not injured. Much blood flowed from the left ear, and a little from the right, and he became insensible. On being bled he became more sensible, but the next day he was again insensible. His pulse was eighty, and weak. Four grains of submuriate of mercury and purging medicines were given him. The third day he kept sleeping, but when roused appeared more sensible. The purging medicines had operated, and his pulse was seventy-two, and weak. Four grains of the antimonial powder and a saline draught were given every four hours. On the fifth day he became quite sensible, but had pain in his head and was entirely deaf. On the seventh day the pain in his head had increased, his pulse was only fifty-four, and his cheeks were flushed. Six ounces of blood were taken from the arm, which relieved him. On the eighth day he continued better, though his pulse was only fifty-four. On the tenth day he kept mending, but when he attempted to walk, his legs appeared very weak. He continued entirely deaf. A great quantity of an aqueous fluid had kept constantly discharging from his left ear, and some from his right.

On the second day after the accident the fluid was very much tinged with blood, but

after that it kept gradually getting paler. On the tenth day it was quite pale. I collected some in a tea-spoon, and made it boil over a candle, but it did not coagulate, and it was saltish to the taste.

Some months after when I saw him he could hear tolerably with the right ear, but remained perfectly deaf of the left.

The functions of the auditory nerves may be impaired so as to produce deafness. When this is the case, the patient cannot hear sounds that he was accustomed to hear, and is at the same time tormented with various noises, which are compared to the undulations of the sounds of bells, humming of bees, waterfalls, &c; and if the complaint increases, he becomes so deaf as not to hear at all without the greatest difficulty.

Though this affection is generally characterized by a loss of the sense with noises tormenting the patient, yet when the functions of the nerves are entirely destroyed, the patient does not complain of any noises. One case of this kind I have seen in a man about sixty years of age. He could not hear the loudest sound in the least degree; and as this usual characteristic symptom of nervous deafness was wanting, I thought the complaint

might arise from imperforate Eustachian tubes, I therefore punctured the membrana tympani of each ear, but it did not make the slightest difference.

The noises attending nervous deafness, likewise attend diseases of the meatus auditorius externus, as when it is filled with hardened cerumen, and likewise when there is a diseased state of the membrane lining the meatus. When there are noises with a loss of the sense, and the meatus auditorius externus and membrana tympani have every appearance of being in a healthy state, if the patient stops his nose and mouth and blows downwards, and feels that peculiar sensation which every one does when the Eustachian tubes are perfect, and if a watch cannot be heard except very faintly when it is in contact with the head, face, neck, or teeth, we may be certain that the disease is in the nerve.

The peculiar noises attending deafness arising from a complaint in the meatus auditorius externus, and those arising from an affection of the nerves, have been supposed to be characteristic of one or other of these diseases, according to the sound it is compared to, but from what I have observed this distinction cannot be satisfactorily made.

Too hasty decisions are sometimes made

in cases where the patient complains of noises attended with deafness, which have been decided upon as owing to nervous affection, when, in fact, I have clearly ascertained that they have been produced by hardened cerumen, the removal of which has immediately cured the patient.

When this disease first comes on, submuriate of mercury should be given every night, and as much sulphate of magnesia or jalap in the day-time as will purge the patient. Blisters should be applied behind the ears once a week, and abstinence from fermented liquors and animal food enforced.

When it comes on, attended by symptoms of a great determination of blood to the head, the patient should be bled, otherwise he may be seized with a fit of apoplexy.

When the remedies I have just advised are used in the beginning of the disease, they will very frequently remove it; but when it has continued long, their efficacy is so doubtful as to deter a surgeon from urging a patient to submit to such tormenting remedies; but that they sometimes succeed contrary to our expectations after the deafness has continued a long time, I shall relate the following cases to prove.

Case 3.

Mr. C. above sixty years of age, had been deaf of his left ear for forty years, and the deafness had been gradually increasing, so that for the last ten years he had great difficulty in hearing any thing with it. He consulted me on May 1, 1819; when he had become so deaf of the right ear, that he could only hear when a person spoke in the loudest tone, and was close to him. He complained of very great noises in this ear, which he compared to the ringing of bells. He supposed the complaint had come on some days before I saw him from cold. He had some uneasiness in his head, which was relieved by bleeding with leeches and purging medicines.

May 5. The deafness and noises in the ear continued unabated, and as there appeared to be some hard wax in the meatus, I syringed it with warm water, but a very trifling quantity was brought away.

8th. No benefit had been derived from the syringing, and as I had no doubt but that an inflammatory action was going on in the labyrinth, I recommended him to have a blister applied behind each ear, and to take five grains of the blue pill at bed-time every night,

and a drachm of the sulphate of magnesia twice a day.

16th. His hearing was improved, though in a very slight degree; and the blisters were to be repeated. After their application his hearing daily improved, and he continued to take the medicines until the twenty-fifth. I now ordered him to drop a few drops of the following liniment into his ears night and morning.

℞. Linim. Camph. ʒij.
Aq. Distill. ʒiss.
Liq. Ammon. gts. x. m.

After this he continued mending; and when I saw him some months afterwards, he said he heard as well of the right ear as he had done for a long time, and much better of the left than he had done for many years.

Case 4.

Mr. L.'s son, nine years old, had been deaf six years, and when I was consulted about him, his deafness was so great that it was with much difficulty he was made to hear any thing. He complained of noises in his ears, and could not hear my watch when put in contact with his face. I made him stop his nose and mouth and attempt to blow downwards, which pro-

duced the sensation in his ears that is always felt under such circumstances. I syringed his ears, but there was no wax in them. I believed this to be a decided case of nervous deafness, and despaired of doing any thing for him; but as his friends were anxious, on the 29th of July, 1818, I ordered a blister to be applied behind each ear, and one grain of submuriate of mercury to be given every night, and six grains of jalap every other morning. He continued these medicines for a fortnight, and had the blisters repeated. After beginning their use his hearing gradually improved till it became quite perfect, and has continued so till the time I am writing this, which is fourteen months since I first saw him.

As the following papers are connected with the diseases of the auditory nerves, and as they contain something new on this subject, I shall, with leave of the Medical and Chirurgical Society, here introduce them.

" Of all the comforts enjoyed by man, none is greater than that of perfect hearing; and when we reflect on the numbers that are deprived of it, and of the little good that can be done for diseases of the ear, this question naturally arises, whether it is owing to our

ignorance, or to an impossibility, that we cannot cure them?

"Insulated facts may at first be apparently trifling, yet when taken into the general account may produce something of the greatest importance. These considerations have induced me to bring this paper before the public; for as I have discovered an anatomical fact which I cannot find any where taken notice of, and as it will account for some part of the physiology of the ear not before generally understood, it may lead to a perseverance in trying to supply some of the defects of that organ, and thereby render a great service to many labouring under its infirmities.

"When the ears are stopped, and a watch is brought in contact with any part of the head, face, teeth, or neck; or if a stick, water, &c. be interposed between any of these parts and the watch, the sound will be heard as well as when the ears are open.

"It has been supposed that the sound is mechanically conveyed through the flesh and bone in the same way it is through a macerated bone, piece of wood, &c.; but if it were so, it must be heard always when the auditory nerve is perfect, at whatever part of the head, face, &c. the watch is applied, but this is not

the case. Where the hearing through the meatus externus has been perfect, and where there has been no apparent alteration in the structure of the head, face, &c. I have seen many who could hear from only one of these parts, and several who could not hear from any of them.

"If I stop my ears and rest my chin on the petrous portion of the temporal bone in a macerated skull, and place my watch in contact with any part of the skull, I can hear the sound perfectly. I saw a boy who was born deaf and dumb, but had been taught to speak, and when a watch touched the left side of his face he could hear it, but when it touched any part of the right side he could not in the least.

"A man who was recovering from an illness had become so deaf of the left ear that he could just hear my watch when put very near it: he heard perfectly of the right ear. I desired he would stop his ears until he could not hear my watch when put nearly in contact with them; I then let it touch the left side of the face, &c: he just heard it, but when I let it touch the right side, he heard it distinctly.

"If sound is conveyed mechanically through the flesh and bone, what in these two cases should hinder it from being heard distinctly,

when the watch touched either side of the face, any more than in the macerated skull?

"If sound is not conveyed mechanically through the head, face, &c. it must be through some other medium, and that I believe to be the portio dura of the seventh pair of nerves, and some other nerves connected with it.

"On dissecting the seventh pair of nerves in man, I find at the bottom of the meatus auditorius internus a communication between the portio mollis and portio dura.

"In sheep I have observed the same communication.

"In fishes several nerves that have a communication with the auditory nerve, are spread on the skin over the whole head.

"If we consider how the portio dura is connected by nervous substance with the portio mollis, its extraordinary course, its receiving the branch of the vidian nerve and the chorda tympani, and, when it has got out of the foramen stylo-mastoideum, its great expansion, I think we may conclude that it was made to serve some greater purpose than has hitherto been ascribed to it.

"That this provision of nature has been useful to deaf people, the following case, which may be found in Haller's Prælectiones Academicæ, will prove. 'Musicus fuit in

aulâ, ex morbo factus surdaster, prehendebat vestibulum mordicùs, et tum omnino chelyn ex arte, pulsabat.'

"That it might be useful to many, could proper instruments be made to increase the effect of sound, and especially to those who are deaf and dumb, if properly persevered in, is, I think, probable; but it must be remembered that, when the disease is in the nerve, no good can be derived from it, which may be ascertained after a few trials by the expression of the child, if a sounding body is applied to the head, face, neck, or teeth; and that many deaf and dumb can hear in this way, I am myself, from experiment, well convinced.

"If from what has been said it should appear probable that sound is conveyed by the portio dura to the portio mollis in man, it will, I think, be reasonable to conclude, that the nerves which are spread on the soft parts of the heads of fishes, answer, in a great measure, the same purpose the tympanum does in man; and though in man this provision is not necessary when the tympanum is perfect, yet when that is imperfect, it becomes the means of conveying sound to the portio mollis, and thus answers one of the most important purposes in the animal economy."

Some time ago the Medical and Chirurgical Society did me the honour to publish in their Transactions a paper of mine on some points relating to the physiology and pathology of the ear. I at that time endeavoured to prove that "when the meatus auditorius externus is stopped, sound is not mechanically conveyed to the portio mollis of the seventh pair of nerves; likewise, that it was probable that it was from the nerves spread on the external parts of the head receiving the impressions of sound, and conveying them to the auditory nerves, that the sense of hearing was produced in fishes: and that man might hear well in this way when the mechanism by which sound is usually conveyed to the auditory nerves was imperfect. I supposed, in consequence, that people born deaf and dumb, and who had no defect in the auditory nerves, might be made to hear through the medium of the facial nerves, and thus have their unfortunate condition in some measure ameliorated.

"I judged that this might be done from having observed that dumb people could hear a watch when in contact with the face, and likewise from a case then related of a musician who was enabled to play by having part of the instrument between his teeth. With

respect to making the dumb understand various sounds, and thereby enabling them to speak, I could then urge nothing more than a probability, but I now, in the following case, have the power of proving how sensible the facial nerves are of the impressions of sounds, and, that what I thought probable is really practicable.

" Elizabeth Nobles, aged thirty six years, was born with the meatus auditorius externus of each ear imperforate. In the right auricle there is a very slight trace of the meatus auditorius externus, and there appears to be no other part of the auricle but part of the helix and the lobus. In the left there is a slight trace of the meatus, but it is only about one-sixteenth of an inch deep; there is the form of the auricle, but the different eminences are not distinct, and the communication between the external air and the membrana tympani of each ear, if these exist, is as completely obstructed as is possible. She did not begin to talk at all intelligibly till she was seven years old, and she did not talk tolerably well before she was about twelve: she can now talk to be perfectly understood. She can hear perfectly when a person addresses her at the distance of six or seven yards. She can-

not hear so well when the person speaking is behind her. She cannot hear a watch unless it is in contact with her face, and not if it is in her mouth, unless it is in contact with some part of it. She herself, as well as others who have known her, supposes that she hears through her mouth and nose, and from observing the motions of the lips. To prove that this is not the case, the circumstance I have related with respect to the watch might suffice, but I made her shut her eyes, and she heard distinctly what I said, as likewise when both her mouth and nose were quite closed. Putting a cloth over her mouth, and nipping her nose, have made a slight difference now and then; but nothing more than I could suppose would happen from the extent of the face the sound was thus kept from. I have pressed my fingers on the parts where the meatus auditorius externus should be, but she heard just as well as before. I have put a thick cloth over them, and at the same time pressed it as close as I could, but it made no difference. I stood four feet from her after having put a linen cloth over her face, and, when I addressed her, she heard distinctly. I then put over the linen a piece of flannel, and she still heard me. I then put over the flannel a large woollen-

cloth coat, and asked her several questions, but she could not hear any of them. I removed all the coverings, and used the same words in the same tone, which she told me immediately. I made the same experiment another day, but she heard all the questions I asked, though more faintly, according to the covering put on her face. Some variation will always exist in these experiments, for it is impossible always to remember the exact tone of voice made use of in them, and some little difference may likewise exist in the coverings. She could hear distinctly tunes played on the piano-forte at the distance of seven or eight feet, and I covered her face, as in the other experiments, and the sounds were fainter. I pressed on her ears with a cloth, but she heard the tunes just as well. I placed her in a chair near the piano, and covered her face so as to hinder her from hearing so well: I then placed her hand on the piano, and she heard much better: I then tied a silk handkerchief tight round the arm, and she did not hear so well, and she heard better again when I loosened it. She cannot hear the sounds of bells at a distance; nor hear the cathedral clock strike unless she is very near, though the hammer strikes on a bell, which is one of the largest in the kingdom, and can be

heard at different times at the distance of several miles.

"When her face or teeth are in contact with the piano, when any one is playing, the sound is very loud to her.

"I made the first experiment at her own house when no one else was present, and the second at my house, after she had walked fast, and before company."

In the case I have related no means were employed beyond those that are made use of for the instruction of children in general, and no pains were taken to make her understand, as is very generally done in the education of dumb children: it therefore may not be uninteresting to enquire, why this faculty of hearing in dumb people, is not even occasionally perfected in those who have had much trouble bestowed on them for their instruction.

May not the reason be (I speak only of those whose auditory nerves are perfect, and who have the portio dura capable of receiving impressions of sounds,) because their whole attention has been taken up with signs, &c. and no methods have been used to increase the power of the provision really made by nature, for supplying the defects occasioned by imper-

fections of the tympanum? I think this may be the case, beeause we find that the sensibility of the nerves, as far as the performance of their particular functions is eoncerned in the production of the senses, is increased by proper use. This I apprehend is the case with all the senses, but I will instance only one with regard to that of hearing. Many young people, it is said, have no ear for music; and, perhaps, if no attention were paid to it, they would never have it as long as they live: but, I believe, in almost every instance of this kind, by proper instruction from a master, and proper attention from the pupil, musie may be taught, so that the learner may have as correct a judgment respecting every part of it, and be made to play and sing as well as many people who have ever so good an ear for it naturally. Do we not find this argument supported by anatomical facts? Many of the nerves, like the muscles, enlarge by constant use. When much irritation has existed in a limb, the nerves of that limb may be found much enlarged far beyond the place where the disease existed, and the nerves will have a healthy appearance, exaetly as muscles have that are enlarged from use, compared with those that have been more inactive. Do we not find in subjects where

the different features of the face are the most marked, that the facial nerves are much larger, and apparently more numerous, than in those where the expression has been less? And is it not the case in very old people where sensation is almost lost, and the nerves have been but little exercised, that the facial nerves are so small and fine as to be with difficulty dissected? If this is true, may we not suppose that in dumb people the facial nerves would have much more power of receiving the impressions of sounds, if they were properly exercised, than when no exertion of this sort is used? I doubt not but that many people have the power of hearing sounds with the face when the mechanism of the ear is perfect, for I have frequently stopped up the external ear as close as possible, yet the human voice has been heard.

Presuming that what I have said is well founded, it is not reasonable to expect that the powers of the facial nerves will ever be fully developed in dumb children if their instructors do not direct by far the greatest part of their attention to the proper exercise of these nerves. And if this is to be done effectually, it must probably first be by the assistance of instruments to increase the effect of sound; and when these have been properly

used, and have answered the intended purpose, then by gradually lessening their power until common sounds can be heard.

OF DISEASES AND INJURIES OF THE NERVES OF TOUCH.

These are so much the same as those of the nerves with which they are connected, that I shall consider them altogether.

CHAP. II.

OF DISEASES AND INJURIES OF THE NERVES OF VOLUNTARY MOTION, &c. IN GENERAL.

In paralytic affections the nerves of voluntary motion are generally those that suffer; and though the nerves of feeling, or those of the skin, generally arise, and are chiefly connected with them, they do not appear to suffer in the same degree that those do which are destined to supply the muscles. As, for example, in a paralytic limb pain and itching will be complained of, and the sense of feeling will remain at the time the muscles have not the power of obeying the will.

That there should be this difference of affection in cases of paralysis, notwithstanding the nerves constituting the sense of feeling arise with the voluntary nerves, and when injured produce the same violent symptoms, is very singular, and can only be accounted for by supposing that the muscles of voluntary motion, require the nerves to be in the most

perfect state to enable them to act, and that a less degree of perfection is necessary for them to perform the functions required for the sense of feeling; for we cannot suppose that when the nerves are so intermixed as they are in the axillary plexus, that the cutaneous nerves alone should escape unhurt.

When much pressure is made on the medulla spinalis, as in most fractures of the spine, all the nerves below the injury lose entirely the power of communicating either sensation or motion to the parts to which they are distributed. When the pressure has been rather less, and some power of transmitting the nervous influence is left, it is sensation in different degrees that is produced. When the pressure is still less, there is along with sensation a feeble power over the muscles; and these circumstances, I think, go to prove what I have stated already, viz. that when the functions of the nerves of a limb are impaired, as in paralysis, they must all equally suffer; and the apparent difference of the effects of the paralysis in the several parts affected by it, arises from the different degrees of perfection necessary for enabling each of them to perform their functions.

Perhaps it will be urged against what I

have said, that it sometimes happens, though it is a comparatively rare occurrence, that the nerves of the skin in some paralytic affections become incapable of performing their functions, whilst those of the muscles are not at all impaired.

Upon due consideration of the subject, we cannot, I think, be much surprised that when the nerves have been divided or injured, as in paralysis, a great difference should exist as to the parts to which they are distributed requiring different degrees of perfection in their restoration, to enable them to perform their respective functions; for the parts to which the nerves producing the sense of feeling are distributed, are to be acted upon mechanically by things external to, and unconnected with the animal; whilst those intended to serve the purposes of voluntary motion, are to be produced by a nicer stimulus, viz. through the agency of the will, which is something so subtle as not to be entirely comprehended by us, either as to the manner in which it is formed by the brain, or how it is communicated by the brain to the parts it calls into action.

Though it is sometimes the case, yet it is, as I have just now stated, a comparatively

rare occurrence for the nerves of sensation to suffer from paralysis, and those of voluntary motion, though arising from the same trunks, to be but little affected by it. When it does occur, I conceive that such an alteration takes place in the skin or the parts composing it, as to prevent the proper exercise of the functions of the nerves distributed to it *.

We know that it is not the nerves being in every respect perfect that can alone produce the sense of feeling, but it is necessary that the skin itself should be in a particular state for the purpose; for we find that the sense of feeling will vary according to the state of the skin, and most particularly of its blood vessels †,

* This affection most commonly arises from a disorder of the digestive organs, and if the brain is affected at the same time, it suffers from the same cause. As far as I have seen, when paralysis arises from pressure on the brain, or medulla spinalis, the voluntary nerves always suffer with those of feeling, and I do not see how it can be otherwise.

† The circulation of blood in an organ or part materially assists the nerves in the production of the sensations peculiar to it, as may be proved by their being entirely prevented, or very much diminished, either by a too powerful or a too feeble action of the blood-vessels. In further support of this opinion, I might mention the different constructions of the organs or parts themselves necessary for furnishing the nerves with a proper supply of blood; but I will merely de-

being at different times more or less acute; and sometimes through the influence of external agents, as from the application of cold, being for a time entirely lost, when no injury or

scribe the curious structure in the nose, which appears to me to be formed for the perfection of the sense of smell.

Beneath the Schneiderian membrane there are numerous sinuses, and many of them of considerable size, which have frequent communications with each other, and appear to be composed of a very thin and inelastic membrane, which is very strong, and perfectly smooth in the inside: within the sinuses are contained very delicate and extremely elastic vessels, which may be called veins, as they appear to be filled with venous blood; and by their being thus situated within sinuses of a determinate size, they are capable of being distended to a certain degree only; which provision is necessary, as their extreme delicacy would otherwise either endanger their very frequent breaking from over-distension, or be the cause of much injury to the very delicate nerves by a too great pressure that would be thus made on them.

This structure, I have no doubt, generally exists in animals, and may be very satisfactorily demonstrated in the horse; and it must, I think, appear to any one examining its peculiarities attentively, that it was not formed merely for returning the blood from the nose, but that it was made for distending the Schneiderian membrane, so as to give it a proper degree of tension to enable the nerves to receive more acutely the impressions from the odorous particles when applied to them; exactly in the same manner that it is required for the nerves of the penis to produce their peculiar sensations, that the parts connected with them should be properly distended with blood.

other circumstance could affect the source from which the nervous influence is derived.

In the same manner, though it is the optic nerve which produces sight, yet the organ must be in a particular state to admit of such production.

When the sensibility of the skin is destroyed, it must be from the state of the skin itself preventing the operation of the functions of the cutaneous nerves, because it is impossible that all the cutaneous nerves of a limb should be paralyzed from any cause affecting their origin, without those of voluntary motion suffering also. I know no experiment that can be made to paralyze the cutaneous nerves, and not those of voluntary motion, except by tying, or dividing the former when they have left the latter. It appears to me impossible that pressure, or any disease acting on the origins of the cutaneous nerves, can paralyze them, without causing an equal defect in those of voluntary motion, which are so intimately connected with them.

It may be said that a particular portion of the brain is allotted for the production of voluntary motion, and another for that of feeling; and that some pressure or disease may exist in one of those parts distinctly from the

other, and thus produce a defect only in the corresponding set of nerves.

When we know decidedly that an injury has been done only either to the medulla spinalis, or any of its nerves, and when the brain is in every respect perfect and uninjured, if there were one particular portion of the brain producing voluntary motion, and another feeling; why or how should one faculty be spared, and not the other? or why should that of sensation always first return?

I have before observed, the only satisfactory way of considering the subject appears to be, that there is no difference between the nerves of feeling and motion, but that they may be sufficiently perfect for enabling the skin to perform its functions, when they are not sufficiently so for the muscles.

I can neither suppose that the nerves of sensation and motion are different, nor that the varieties of sensation are produced by the endowment of different branches of the same nerve with different faculties. It is, I think, generally considered that the nerves alone are capable of producing the different sensations, and the parts or organs constituted in a peculiar manner for the reception of the nerves, take no part in their production.

CHAP. III.

OF DISEASES OF THE NERVES OF VOLUNTARY MOTION.

These diseases are of two kinds, active and passive.

The active diseases are all those affections of the nerves attended by pain, and frequently by a motion of the affected part, as tic douloureux, &c.

The passive are those affections termed paralysis.

In the active, at the part which appears to be the seat of the disease, there is an increased action of the blood vessels, and likewise an increased heat, whilst in the passive there is quite a contrary state.

Those local complaints which appear to originate spontaneously, or in some cases where a slight wound has been inflicted, I believe to be only symptomatic of a general irritability of the brain and nervous system. The almost constant failure of topical remedies,

and of the division of the affected nerve, must lead to the conclusion that the cause of the local diseased action, or primary affection, must reside in some other part of the body: and if we inquire into the causes of the local active affections of the nerves, it will be found that the atonic state of the body, or whatever tends to render the brain and nervous system irritable, will generally be found the most frequent.

These complaints more frequently occur in women than in men, and it is, I think, generally allowed that the brain and nervous system in women are much more susceptible of irritation from slight impressions, and they occur the most frequently in them at that time of life, when the powers of the body are beginning to diminish, and the actions of the system to become irregular.

This irritability of the brain is produced by any excessive exertion of its powers, such as a too constant attention to business, or too much subjection to the depressing passions, by irregularity in the mode of living, a too frequent use of fermented liquors, disorders of the digestive organs, or any other cause that tends to weaken the body.

There is no part of the body that is not

affected by the state of the stomach, and it is therefore not difficult to conceive that the nerves should feel its derangements more than any other parts, as it is through them its various states are transmitted; but why part of a nerve should suffer without any alteration in its organization is almost inexplicable, nor is there much less obscurity in those cases where a slight wound has been inflicted.

By the means above enumerated, the brain and nervous system, originally healthy, are rendered morbid in their actions; but there are some people who are naturally susceptible of this irritation, from their being descended from parents who were subject to mania, or a great irritation of the nervous system; and I have known an instance of this kind where only a slight injury was inflicted, where the affection of the whole nervous system, in consequence, was greater and more obstinate, than in any other case I have ever heard of.

It perhaps will not be required that I say any thing of those affections of nerves which are only sympathies with some distant part, of which many instances may be enumerated; as pain in the knee, when the disease is confined to the hip; pain of the shoulder, when the liver is affected; and, what I have occasionally

known, pain in the neck, from disease of the lungs; pain in the penis, in cases of stone in the bladder, and many other similar affections. All these affections are so common that it would be useless to relate cases to prove them.

CHAP. IV.

OF PAINFUL AFFECTIONS OF THE NERVES OF THE HEAD AND FACE.

These complaints have been variously denominated,—intermitting pains of the head; hemicrania; tic douloureux, &c; but they appear to be all the same disease, only varying in situation and degree. They come on generally in paroxysms, and in many instances periodically, recurring at nearly the same hour daily.

The pain attacks sometimes the whole head, sometimes half of it, sometimes the face, but generally only one side of it, and frequently only part of that, as one eye, the upper lip and nose, the gums, &c. It varies, in different people, from a common head-ach, though it is generally more severe to the most exquisite anguish that is ever suffered in any disease that man is liable to. During the paroxysm, the parts will frequently be in such an agony as to deter the patient from moving them for any

purpose. The length of the paroxysm varies very much, returning very often at uncertain periods, though in many cases, as before observed, at nearly the same hour daily. It is most regular when the complaint is beginning, and, if no remedies are used for it, will become almost continual.

In the beginning of the complaint the pulse is generally natural, though it is sometimes rather quicker, the appetite is most commonly bad, and the spirits depressed.

I have known patients who have had a paroxysm of most intense pain, which has lasted only a few minutes, come on for several days together, and go away spontaneously, though in most instances it will continue many months if its course is not interrupted by medicines.

When the pain is confined principally to the head, and has become almost continual, it may be suspected that there is some disease within the cranium; on the contrary, if there is a perfect intermission in the twenty-four hours at about the same time, or if the pain, though constant, becomes more violent once in twenty-four hours at about the same hour, and continues so for some time, and then somewhat abates; if it strikes down the face,

and wine does not increase it, and if the patient has been bled from the arm, and has experienced no relief; in all these cases, it may be judged to be an affection of the nerves without the cranium.

The exact nature of tic douloureux has not, I believe, as yet been ascertained. Anatomy has not been able to throw so much light on this subject as to lead us to draw any satisfactory conclusions from it.

It generally happens that this complaint of the nerves, especially when it has been of long duration, is attended by an increased heat of the part, and likewise by a local increased action of the blood-vessels; as is frequently shewn by the appearance of the parts to which the affected nerve is distributed, and frequently by the increased secretion from the salivary glands, when the nerves distributed to these parts are affected.

It appears to me that the irritation of the nerve is the cause of the increased action of the blood-vessels; nevertheless, this increased action may tend to increase or keep up the irritation of the nerve.

It has frequently happened, after an operation in which a nerve has been principally concerned, that either during the healing of

the wound, or after it has become completely cicatrized, if an increased action of the blood-vessels is produced, as is shewn by inflammation about the part, the painful sensations resembling tic douloureux are produced. By this I would not say that in this complaint there is an inflammation of the nerve, because I think other facts go to prove that there is not, but it shews that the increased heat and action have a decided effect in keeping up the complaint. The nerves may become enlarged from irritation, as in a case I shall relate, in the same way the muscles are from continued action; but when there has been inflammation of a nerve, though only of the chronic kind, and to which sort that of tic douloureux must bear the greatest resemblance, if it were inflammation, there would be the same change of structure that takes place in all continued inflammations of other parts of the body, viz. an enlargement from the deposit of coagulable lymph. This is shewn when there has been a chronic inflammation of the extremities of the nerves in a stump, or when the nerves have been confined to a part that has been long subject to inflammation; and if this had been the case in tic douloureux, I think it would not have passed unnoticed.

We are not much better informed respecting the causes of this complaint than we are about its nature. In some instances it seems to be an original affection of the nerve.

Sometimes it is produced by irritation, as from an ulcer connected with a branch of a nerve; sometimes from a decayed tooth, from the anastomoses between the affected nerve and those of the teeth, but most frequently from some disorder of the constitution.

It seems to be an exactly opposite affection of the nerves to paralysis, for in this complaint there is most excruciating pain, and an increase both of the heat and action of the affected parts, and it is generally attended by debility of body; whilst, on the contrary, in paralysis there is generally no pain, there is a diminution of the heat and action of the parts, and it generally attacks those whose constitutions are in a strong and healthy state.

We find that debility of the body is a state the most fitted for keeping up an irritation of the nervous system; and when any part of it has once become irritated in a subject to which we might suppose there was a predisposition, a habit is formed so as to continue the irritation, which generally becomes stronger and more obstinate, the longer it is unopposed by such

remedies as have the power of breaking through it. Sometimes the complaint will terminate spontaneously, appearing to have worn itself out; and sometimes it will be relieved by the coming on of another disorder, as in the following case.

Case 5.

Mr. H. forty-three years of age, received a blow on the right eye, which produced a great extravasation of blood between the conjunctiva and sclerotica; he was likewise bruised on the head. He could see very little with this eye before the accident, but he was now entirely blind. At first he complained of very violent pain in the eye, for which he was bled, took purging medicines, and used cooling washes. Shortly after he complained of stabbing, or darting pains, which went from the temple down the face, and sometimes to the ear; they came on in paroxysms, and were at first very violent and frequent, and were always confined to the nerve. His complaints continued for ten weeks: at first the attacks were violent and frequent, both day and night; they then seldom came on in the night; afterwards they became gradually fewer; at the end of ten weeks he had two or three every day, when

an eruption like that of the nettle rash came all over his body.

After this he had no return of the pain, he improved in his health, and became entirely free from complaint.

During all the time before the eruption his spirits were much depressed. Much anxiety always increased the paroxysms, as did likewise any thing that caused him to be angry; much stooping, or motion of the head, likewise brought them on. During the paroxysms there was a great pulsation of the temporal arteries.

He used no particular remedies but those first prescribed for him, except occasionally some leeches, as the pain, though very excruciating, kept gradually diminishing.

In this instance the pain was produced by the injury, but the constitution seemed to be concerned in its continuance; as was proved from its entire removal, as well as of all the other nervous symptoms, by the eruption.

After the eruption his appetite became good, which had not been the case for a length of time.

There appear to me to be two principal indications of treatment for the cure of this complaint: the first consists in strengthening the constitution, and thereby enabling it to

counteract the habit which favours the continuance of the irritation; the second, in allaying the local irritation.

The first is best fulfilled by the exhibition of tonic remedies in doses, which must be repeated frequently, and at regular intervals, so as to produce new and regular actions: and when the diseased action is very violent, sedatives must be given, both with a view of alleviating the pain, and assisting the constitution to overcome the morbid actions. The best tonic remedy for effecting this change is bark, which should be taken regularly in doses, from half a drachm to a drachm every three or four hours, day and night: wine and malt liquor should be allowed rather freely. In this complaint the digestive organs are frequently disordered, but I have often known them restored during this plan of treatment.

I think arsenic a very doubtful remedy, and to be administered with great caution; and that mercury should be likewise used very sparingly.

Besides the use of medicines, the patient should be regular in his diet; he should take regular and gentle exercise, and cease from every exertion of the mind that can be attended with any irritating effects.

The second indication of cure is best ful-

filled by reducing the heat and action of the part by leeches and evaporating lotions; and if cold applications disagree, the pain may be moderated by fomentations and the use of an opiate liniment.

I relate the following case to shew that the periodical pain of the face and tic douloureux are the same affection of the nerves, and likewise to shew the manner in which the bark should be administered to produce its beneficial effects.

Case 6.

Mrs. P. forty-eight years of age, had complained of a violent pain in her face, which extended up the head, and was supposed to proceed from the stump of a tooth. On the eighth day after its first attack I saw her; she complained of very excruciating pain, which came on at nine every evening: it was not the continued pain of the tooth-ache, but came on in excruciating paroxysms, which lasted two or three minutes, and then abated. She would continue easy for a few minutes, and then again the pain would recur; and in this manner she passed her time until seven in the morning, when she became quite easy, though the pain would return occasionally at different times in

the day. It seemed to be confined to the upper branches of the portio dura of the seventh pair of nerves. As it was supposed to proceed from a tooth, the tooth was extracted; and as her mouth was inflamed, she took four grains of submuriate of mercury and some purging medicine. On the tenth day I saw her again, when she had received no benefit from what I had done for her. I ordered her the following draught, to be taken half an hour before the pain came on, and the powders to be taken regularly every three hours through the day and night.

℞ Tinct. Opii. gts. xl.
Liq. Ant. Tart. gts. xv.
Aq. Puræ. ℥j. Mf. Haust.

℞ Pulv. Cinchon. Cordifol. ℥ss.
—— Zinzib. gr. iij. Mf. Pulv.

On the eleventh day I saw her again; the medicines had been taken regularly, and she had passed, upon the whole, a better night.

On the twelfth day: she had a much better night, and the pain was diminished so much, that she could bear it without crying out.

Thirteenth day: she had a tolerable night, the pain being trifling compared with what it had been.

Fourteenth day: she complained of many attacks of pain yesterday in the afternoon, and at night.

Fifteenth day: she had not had one attack of pain since yesterday, and slept well without the draught; she continued to take the powders some days longer, but never had any return of pain.

In cases where the disease has been of long duration, much more time will be required before the beneficial effects of the bark are perceived; but it must be persevered in, and taken regularly through the day and night, or it will not be found often to succeed.

This complaint may be produced by a slight injury, as it is in the nerves in other parts of the body, as in the following case.

Case 7.

Mr. M. seventeen years of age, applied to me on account of an excruciating pain in his face, for which he had used remedies prescribed for him without any relief. About two months before he received a blow on his face, which broke one of the middle incisor teeth of the

upper jaw; some swelling of the face was occasioned by the injury, but in a short time it entirely subsided. When I saw him there did not appear to be any particular cause for the pain, as his general health was not much impaired, but he had become thinner by the continuance of the pain. I ordered him to take two scruples of powdered bark with the following draught every three hours, and to drink several glasses of wine daily.

℞ Decoct. Cinchon.
Infus. Caryoph. āā. ʒvj.
Syrupi ʒj Mf. Haust.

After the use of these remedies for a short time the pain entirely left him, but confinement again brought it on, when recourse being had to the bark in larger doses, the pain gradually subsided, and he afterwards had no relapse.

I have before observed, that whatever tends to weaken the body produces a morbid sensibility of the nervous system, and disposes to the production of this complaint of the nerves; as in the following case, when the complaint came on from an affection of the nervous system, in consequence of poison being taken into the stomach.

Case 8.

Mr. B. having eaten some hashed hare, which was afterwards discovered to have stood in a brass pan (found on examination to be covered with verdigrease), became ill, as did others who partook of it. From this time he was never well; and when I saw him some months after, he had an affection of the nerves at the back of the head, which caused excruciating pain, and had tormented him a long time. He had become very weak and much emaciated in consequence of the almost continual severity of the pain, and in short he quite despaired of ever being better. He had used a variety of remedies, without any abatement of the complaint.

I ordered him half a drachm of powdered bark to be taken every three hours, and a blister to be applied to the back of the neck; and as the pain was usually more severe in the morning, he had a draught, with thirty drops of laudanum, to be taken at that time; and I recommended him to drink wine and malt liquor. Soon after he was put on this plan of treatment the pain began to be less severe, and it kept gradually diminishing, and at length quite left him. As the pain diminished, his

bodily strength increased; and in the course of some months he became as strong as he had ever been at any period of his life. At first the bark was taken regularly every three or four hours, but afterwards not quite so regularly, and it was continued altogether for about six weeks.

When the complaint is confined to a particular nerve, and comes on with such excessive violence, and in frequent paroxysms, and the bark has failed in giving relief, it is difficult to know what most to recommend. The arsenical solution, some narcotics, as belladonna, cicuta, and extract of stramonium, have been given in some cases with advantage; but there are many cases, on the contrary, in which none of these have succeeded; and when they do not, and the patient's sufferings are very great, the division of the affected nerve must be tried, which has been sometimes successful, though, on the other hand, it has very often been performed without effect.

When every thing else has failed, a discharge of matter, produced by a seton, or issue, made as near to the affected nerve as possible, has in some cases relieved the complaint; and sometimes the application of the actual cautery over the part where the affected nerve is situ-

ated has entirely removed, or very much mitigated the violent symptoms.

The nerves most affected, and which it is generally the most necessary to divide, are the supra-orbital; the second branch of the fifth pair, where it passes out of the infra-orbital foramen; the portio dura of the seventh pair of nerves; and the termination of the third branch of the fifth pair, where it passes out at the foramen in the lower jaw.

When the supra-orbital nerve is affected, pain will be felt in the forehead, shooting towards the orbit.

To divide this nerve, an incision should be made a very little above the supra-orbital foramen, down to the bone.

When the second branch of the fifth pair is affected, the pain is principally confined to the parts about the upper lip, and ala of the nose, on the affected side. When it has continued a long time, the branches of the nerve which are given off before it comes out of the infra-orbital foramen become affected.

The infra-orbital foramen, at which the nerves come out to the cheek, is situated at about a quarter of an inch, and in some subjects at a little further distance, from the inferior edge of the orbit; so that in every subject,

by making an incision with a small-pointed knife, at three quarters of an inch below the inferior margin of the orbit down to the bone, the nerve will be divided.

When the portio dura of the seventh pair of nerves is affected, the pain is principally in the cheek and side of the head, and extends to the ear.

To attempt to divide the trunk of this nerve will not only be very difficult, but it will be likewise very dangerous: and to divide all the branches that go to the face, requires an incision from the zygoma to the angle of the jaw; but the greatest portion may be divided by making an incision down to the jaw, a little below the zygoma, and thus the main branches of the nerve will be cut through; and if the patient is not relieved by this operation, another incision may be made quite on the angle of the jaw, by which nearly all the principal branches will be divided.

When the third branch of the fifth pair is affected, pain is produced in the side of the tongue and the teeth of the lower jaw. This nerve it would be very hazardous to attempt to divide; but when the lower lip is suffering from an affection of this nerve, where it passes out at the foramen in the lower jaw, its division

must be effected by passing the point of a knife, at the root of the first bicuspis tooth, between the lip and bone down to the foramen, and moving it a little from side to side.

After the division of a nerve a compress of lint must be placed on the wound, and confined there with sticking-plaster.

CHAP. V.

OF PAINFUL AFFECTIONS OF VARIOUS NERVES.

Sometimes the nerves in other parts of the body are affected in the same way as those of the head and face, of which the following case is an instance.

Case 9.

Mrs. W. had a pain in the left arm, which extended in the course of the ulnar nerve from the elbow to the little and ring fingers, both of which were weak and painful to the touch; the pain was not constant, but came on by fits: there was an evident disturbance of the digestive organs, with palpitations of the heart.

She used a spirituous embrocation for the arm, and took five grains of the mercurial pill at bed-time, and a mixture with camphor and the volatile tincture of Valerian, by which the pain was diminished. She was then attacked by a severe affection of the uterus; and after

some time, when she was recovering from this complaint, the pain in the nerve ceased entirely, and never returned.

A similar case is related by Mr. Earle, in the seventh volume of the Medico-Chirurgical Transactions, in which the complaint was more violent and obstinate, and was cured by cutting out a portion of the ulnar nerve, just as it passes behind the inner condyle of the os humeri.

A very interesting case of a lady is related by Mr. Abernethy, in his Surgical Observations, where the complaint was seated in the integuments under, and adjoining to the inner edge of the nail of the ring finger of the left hand, and which was ultimately cured by cutting out half an inch of the digital nerve on that side of the finger.

In tic douloureux, as has been before observed, a simple division of the nerve has in several instances succeeded in curing the patient, but in many others it has entirely failed. Whenever it can be done, a piece of the nerve should be removed, if there be no particular reason forbidding it.

When a nerve has been in a state of irritation for a long while, a very trifling thing will keep up the irritation. In such cases I believe

that an enlargement of the nerves frequently takes place, as in the case of William Sharpe, which I shall presently relate; and that a long time is necessary before they will return to their proper state, after the irritating cause has been removed. For this reason, I think the mere division of a nerve does not give a sufficient time for the parts to be restored before it can again perform its functions; that is, for the parts to have forgotten the irritation they were used to, till their communication with the brain was cut off. At what time a nerve is sufficiently restored after its division for conveying the nervous influence, or whatever it is it conveys from the brain, so as to produce pain, it is very difficult to say, though the cases I am going to mention may seem to throw some light on the subject; but from observations we are able to make in paralytic limbs, I should think long before it is sufficiently restored for serving the purpose of voluntary motion, for I have frequently known paralytic limbs painful when the muscles have not had the least power of motion. If this be so, two advantages are derived from cutting out a portion of the nerve; in the first place, because the divided portions would be longer in uniting, and more time would thereby be afforded for the dis-

eased action of the parts to wear off; and, secondly, because they would retract out of the reach of the external wound, and be less liable to partake of any inflammation or other irritation occasioned by it.

From the experiments * made by Dr. Haighton on the par vagum, it seems that the substance by which the divided nerve is united, produces some communication of the nervous influence at the end of nine days, and that in six weeks it has very considerable power to that effect. It appears that the reunion may be established sufficiently for the reproduction of the distressing symptoms in twenty-four days; as in a case † related by Sir Everard Home, where the patient was affected with spasms from an injury of the thumb, which began always in the thumb and fore-finger, and for which the branch of the median nerve going to these parts was divided.

Perhaps it will be said, that in these cases the communication of the nervous influence was carried on by anastomosing branches; but I think Dr. Haighton's experiment, in which he again divided the par vagum on each side, nineteen months after their first division, must

* Philosophical Transactions for 1795.

† Philosophical Transactions for 1801.

prove beyond all doubt, that the performance of their functions after the first division depended entirely upon their reunion, or the communication by anastomosis must have become so much developed as to have prevented the animal's death after the second division.

I think it is a question whether the nerves have the power * of communicating their influence to other nerves whose communications with the brain have been cut off, in the same manner the arteries have whose direct communication with the main trunk has been intercepted by a ligature; but I think we may safely say, that at all events it can only exist in a trifling degree, and in some particular cases. Tie the femoral, or even the external iliac artery, and divide the sciatic nerve, and see how wide the difference will be: scarcely any inconvenience is felt from either of the former, for the limb is immediately nearly as well, as far as

* This may appear a physiological question, and not sufficiently connected with my subject; but it seems a point of great importance to be determined, as if it should be proved that there is a sufficient communication by anastomosis between the nerves for keeping up a communication with the brain, when the nervous influence has been intercepted in its regular course, portions of nerves might be frequently removed, and amputation of the limb often prevented.

the circulation of the blood is concerned, as it was in its most healthy state; whilst the latter is a great many months in feeling the perfect return of the nervous influence; and if a portion of the nerve has been removed, it will be very long indeed before such a reparation is effected, so as to enable the parts to perform their functions even in a manner just sufficient for their preservation. If a large portion of an artery is destroyed, still no inconvenience is felt; whilst on the other hand, when even the ulnar nerve is divided, or a portion of it removed, how long is it before it can again convey the nervous influence.

In a case * related by Mr. Earle, when he cut out a portion of the ulnar nerve behind the inner condyle of the os humeri, five years after the operation, the little finger remained nearly useless, and sensation was very imperfect. Now if the supposed communication existed even in a small degree, would not the anastomoses between the portion of the ulnar nerve below the division, and the median, spiral, and internal cutaneous nerves have kept up a sufficient communication with the brain, had the transmission of the nervous influence been easy?

* Medico-Chirurgical Transactions, vol. vii.

With the same anastomoses, would not the ulnar artery have kept up immediately a very brisk circulation? I think nature never intended that so free a communication should exist amongst the nerves as amongst the arteries; and for this reason, that when a large artery is wounded, the wound is very rarely if ever healed, so as to restore its calibre, and render it capable of performing its functions: whereas a simple wound of a nerve, with very few exceptions, is so effectually repaired as to enable it to act nearly as well as before.

I relate the following case to shew how little power the anastomosing branches have of conveying the nervous influence.

Case 10.

February 8, 1820. Joseph Mason, aged thirty-one, asked my advice about a troublesome ulcer on the fore-finger, which arose from a blister produced by the frost. He gave the following account of himself: That two years ago he fell from a scaffold on an axe, and cut his fore-arm at a distance of three inches from the wrist. The cut appeared to have extended across the arm, to have been very deep on the radial side, but of little depth

on the ulnar side: the ulnar nerve did not appear to have been wounded, as he had the feeling in the little and ring fingers, and in the corresponding parts of the hand to which the ulnar nerve is distributed. He has no feeling in the thumb or the other two fingers, or in the corresponding part of the hand, either in the palm or back of it; so that it appears as if both the median and radial nerves had been completely divided. The parts deprived of the nervous influence are constantly cold, whilst those parts to which the ulnar nerve is distributed are warm. He feels as well on the radial side of the ring finger as on the other; but does not recollect whether this was the case at first, or how long it has been so.

CHAP. VI.

OF INFLAMMATION OF NERVES.

Nerves are subject to inflammation, which takes place generally from their contiguity to inflamed parts. When a nerve partakes of the inflammation of the part in which it is situated, it becomes increased in size from a deposit of coagulable lymph between its fibres.

An idiopathic acute inflammation of a nerve is, I believe, a very rare occurrence.

Chronic inflammation is sometimes affecting nerves, and generally occurs in their extremities in stumps: they appear enlarged in these cases for some distance, and their extremities are swollen into a gangliform tumour, very much like that enlargement produced as the bond of union when a nerve has been divided. If the nerve and tumour are divided perpendicularly, the nervous fibrils may be traced down to the tumour, and coagulable

lymph appears to have been deposited between them; but the horizontal section of the tumour has a close and uniform appearance, nearly like a piece of cartilage. When the nerves are in this state, the patient suffers so much pain from the least touch as to be obliged to submit to a second amputation.

In many instances of the complaint called sciatica, I believe the sciatic nerve to be the seat of the disease; the pain is generally so exactly confined to the situation of that nerve, and the adjacent parts are so free from any appearance of disease, that I believe the nerve to be the only part that suffers; and the complaint, as I conceive, is arising from an inflammatory action in the nuerilema, which frequently ends in an effusion of a serous fluid.

When people of a very robust habit are affected with this complaint, it is necessary to take some blood from the arm, at the same time local evacuations of blood are necessary; afterwards a large blister should be applied over the seat of the pain, and purgative medicines should be administered.

When the complaint does not give way to these remedies, the extract of stramonium should be given in doses of a quarter of a

grain, gradually increased to two grains, three times a day. In some instances, when every thing has failed, an entire confinement to bed, and tonic medicines, with as much opium or other anodyne as will moderate the pain, has been found to succeed.

In obstinate cases, it will also be of use that an issue should be made near the trochanter, and that a grain of submuriate of mercury should also be given every night.

The following case is related as an instance of this complaint.

Case 11.

A man about thirty years of age had a most excruciating pain from the hip to the knee, which was confined to the sciatic nerve; there was no swelling, nor any particular tenderness on pressure: the pain had been coming on some days, and was much more violent than that complained of in rheumatism. Blood was taken from the buttock with cupping-glasses, which gave him considerable relief, and then a large blister was applied to the same part: he took four grains of submuriate of mercury with ten of the compound powder of ipecacuanha at night, and a purging mixture in the morning.

Two days after I saw him again, when the pain had almost entirely left the hip, but continued as violent as ever in the knee: a blister was now applied to this part, and after taking two grains of submuriate of mercury with ten of the compound powder of ipecacuanha for three nights, the complaint was entirely removed.

CHAP. VII.

OF ULCERATION OF NERVES.

I INTRODUCE the following case for two reasons: in the first place, because it shews that when a disease has existed in a limb for a long time, its nerves become very much enlarged; and secondly, because it shews that the nerves may be in a state of ulceration, and are then attended with excessive pain.

Case 12.

William Sharpe, a soldier, aged fifty-four years, when about fifteen years old, was wounded in the tibia by a splinter of wood. A piece of this bone exfoliated, and the wound was perfectly healed in nine months, and he continued well until the year 1814, when he received in the same part a kick from a horse, which made a wound that continued open, and became so extensive as to occupy a space of

about six inches in length, and three in breadth.

Some small pieces of bone exfoliated, and the ulcer gradually got worse, and in June, 1817, began to have a fungous appearance: in June, 1819, it had still the appearance of a fungus, which bled very much on being touched, and small bits of bone continued to exfoliate. For about two months escharotics, as muriate of antimony, &c. were applied to the sore, which destroyed the fungus, so as to make it nearly even with the skin. Before these applications, he had suffered such violent pain in the thigh and leg as far as the ancle, that he wished to have the limb amputated; but it was hoped that the above applications might reduce the fungus, and allow the wound to heal. This, however, not being the case, he was so wearied by the continual pain (for he hardly ever slept), that I amputated the limb above the knee on the 30th of June, 1819; he never after had any pain in the thigh, and in a month was quite well.

On examining the limb, the skin for some distance round the sore was very much thickened, the whole of the bone upwards was enlarged, and where the ulcer was situated there was a very considerable hollow in it, which was

filled up by the fungus; in this hollow the bone was very spongy and soft, but none of its exterior part seemed dead. The fungus seemed to grow from the hollow in the bone; and not to be, as was supposed, occasioned by the irritation from some exfoliating bone.

The greatest part of the muscles of the leg had lost their proper characters, in most places having their fibrous appearance, but very much resembling fat.

The sciatic nerve was very much enlarged, but many of its branches were more so in proportion.

The greatest part of the nerves was covered with a layer of a substance resembling fat, but very different in appearance from the other fat of the limb, or from that which is usually about the nerves; when freed from this, most of them had the nervous appearance, though they were apparently of a closer texture than sound ones. Several varicose veins were observed in different parts of the sciatic nerve. Some of the nerves were unusually soft, being easily torn. The following is a particular description of each nerve.

The branch of the anterior crural nerve that accompanies the saphena major vein was somewhat enlarged; about an inch and a half

above the ulcer it was still larger, and even with the ulcer, by which it was nearly surrounded; at the upper part it was firmly united to the adjacent parts for an inch and a half, after that it was loosely connected with them, and then again for rather more than two inches it was firmly united to them; near the malleolus internus it became of its natural size and appearance.

The fibular nerve was very much enlarged; and the anterior tibial and cutaneous, or fibular, which it divides into, were nearly twice the size they are in a healthy limb. The fibular proceeded of the same size down the leg, part of it was surrounded by the ulcer, to which an inch and a half of it was firmly united; and one inch of this appeared rather smaller, and was in a state of ulceration, so much so in one place as to be nearly divided: after this it had the same size as in the upper part of the leg as far as the instep, when it divided into branches; at this division they were rather larger than natural, but as they approached nearer the toes, they became of their natural size and appearance.

The anterior tibial nerve enlarged proceeded firmly united all the way to the surrounding parts; near the ulcerated parts the tibia was so much enlarged as to leave a very

little space between it and the fibula, and here for some way the nerve appeared less, and so confused as to be only just recognized; it then again became enlarged, and continued so as far as the instep, where it divides into branches.

The cutaneous branch given off from the fibular, before its divison, was very much enlarged.

The posterior tibial, at the upper part, was larger than natural; but towards the bottom of the leg it was still larger, and continued so until it had got beyond the malleolus internus: about the middle of the foot its branches were of the usual size.

Bichat, in his Anatomie Generale, says, "I preserve the sciatie nerve of a subject, who experienced very great pain through its whole extent, and which presents at its superior part a number of small varicose dilatations of the veins, which penetrate it."

Now as the sciatic nerve where the limb was amputated, in the case of William Sharpe, had these same varicose veins, we may presume on their having been more high up. In him I cannot for a moment suppose that the pain was owing to these dilated veins, as he never had any pain after the limb was amputated,

and the stump healed very well; a clear proof that though the nerve was enlarged, it was not diseased; but that the enlargement, as well as the pain, proceeded from the ulcerated state of the parts in the leg.

When a disease has existed in the hip joint a long time, do not the nerves become enlarged? If they do, is not this the cause of an issue keeping up the irritation, and nearly the same symptoms, when the disease or inflammation of the joint has gone off?

To shew further how violent the pain is when the nerves are in a state of ulceration, I shall introduce the following extract from a case* related by Morgagni, of an aneurism in the right groin, which extended backwards so much as to produce an ulceration of the sciatic nerve.

"In the last month the pains became most severe, not only in the tumour, but sometimes beneath the internal malleolus; in which place only, violent as the pains were, the foot was sensible, being in every other part deprived of feeling and motion. In all this month he neither had an interval of ease nor any sleep until his strength failed; then for some days he lay half asleep, and so died.

* Morgagni de Causis et Sedibus Morborum.

"On examining the limb, the nerve was so much eroded, that a few fibres hardly remained by which the superior and inferior parts were joined together."

The following case I consider to be similar to that of William Sharpe, and as shewing that the nerves were involved in the disease.

Case 13.

A man had a fungous tumour on the lower lip, and suffered from it very excruciating pain, much more than is commonly experienced in cancer, and it very much resembled the tic douloureux.

I cut out the diseased part, and brought the edges of the wound together by means of the interrupted suture, and in a week it was perfectly healed, and in every respect quite well.

About a week after this he came to me again, and said he was afraid the whole of the disease was not removed. On looking at the lip, I observed the upper part of the cicatrix was rather redder than it should be, and there was the least possible tumefaction about it; but there was nothing in its appearance to account for the excruciating pain he suffered.

I ordered two or three leeches to be ap-

plied to the lip, and as he had evidently a disordered stomach with a furred tongue, I ordered him such medicine as would correct it.

The leeches very much relieved him, and in about a week his stomach was much better, and he did not again complain of the pain; and when I inquired of him several years after, he remained perfectly well.

It appeared to me that this was an inflammatory action in the part, and that the nerves had partaken of it more than they generally do under such circumstances, and it shows how easily they are affected when they have been long irritated.

That the fungous ulcer in this case affected the nerves of the lip was, I think, proved by the severity of the pain; and that the inflammatory disposition in the cicatrix afterwards produced the return of the pain is proved by other cases, where the nerves have become inflamed; and particularly by the following one related by Sir Everard Home in the Philosophical Transactions.

Speaking of tic douloureux he says, "In one case of this disease in which the operation of dividing the nerve was performed with a view to remove the complaint, union by the

first intention did not take place, and during the time the wound was open, the inflamed state of the cut end of the nerve made the patient liable to several attacks of the disease, similar to those he experienced before the operation; but there was no occurrence of them after the wound was completely healed."

In people advanced in life, the teeth of one jaw are sometimes entirely lost, so that those of the other are apt to press very much on the soft parts of the mouth, and produce slight ulcerations, which sometimes cause very violent pain, exactly resembling the tic douloureux; so that in all cases of tic douloureux, which will not yield to the usual remedies, the mouth ought to be carefully examined, as, if there is an ulcer produced in this manner, the symptoms can only be cured by extracting the tooth.

CHAP. VIII.

OF TUMOURS IN THE NERVES.

When a tumour is forming in the substance of a nerve it causes very violent pain, which sometimes affects the whole nerve in which it is contained. The pain is very much aggravated by any pressure made on it, and when it is moved. It is generally moveable from side to side only, as the upper and lower extremities are confined by the nerve.

It may be distinguished from all other tumours by the excessive pain pressure occasions, and from its shooting generally exactly in the course of the nerve in which it is situated; but with respect to this diagnostic symptom, Mr. Charles Bell, in his Operative Surgery, relates a circumstance which is contrary to what generally happens in cases of tumours in nerves. It is that of a man who had been bruised at the back of his thigh, and from which he apparently recovered. Some

time after he began to be much troubled with a violent pain in his foot, which he suffered for two years. At the end of this time a tumour was discovered in the ham, which, when pressed on, did not give any particular pain, but rather a sense of prickling numbness down the leg. He was then in a dying state, and only lived a few days after.

On dissection some nerves were found running over the tumour. The sciatic nerve entered into the substance of the tumour, but the fibular nerve, though close on it, was not incorporated with it.

Tumours, though generally situated in the larger nerves, are sometimes found underneath the skin in the cutaneous branches.

There is no method of alleviating the patient's sufferings but by the removal of the tumour, when the knife will be found a mode far more preferable than any other.

It is generally much better to cut out the portion of nerve in which the tumour is situated, than to dissect the tumour out of the nerve.

If the tumour is not removed, the constant and violent pain it occasions keeps gradually wearing away the strength of the sufferer, and he dies at last completely exhausted.

The following case is an instance of a tumour connected with a cutaneous nerve.

Case 14.

Mrs. H. had felt a pain in a small spot about the middle of the leg, for which no cause could be assigned. At the end of two years a very small tumour could be felt, which, when pressed, gave very great pain. At the end of seven years it had attained the size of a large pea. The pain she suffered was very great, and was always brought on and aggravated by surprize, fear, or any affection of the mind, and likewise by cold. Keeping the whole body warm always relieved the pain. After she had suffered very much she consulted a surgeon, who divided the skin over it, and recommended the wound to be kept open, and caustic to be frequently applied to it. It was treated in this way for three months, but without any good effect. Some time after I saw her, and cut out the tumour, with the surrounding portion of skin. When cut into it had a cartilaginous appearance, and a cutaneous nerve was seen passing between it and the skin, and an expansion of the nerve was spread over it.

After its removal all the distressing symptoms left her, and never returned.

A woman* was cured who had frequent fits of epilepsy, which began with great pain in the thumb of the right hand, by the extirpation of one of these tumours, which was situated near the articulation of the first with the second phalanx, on the side next to the palm of the hand. The slightest compression of it gave great pain, and frequently brought on the fits of epilepsy.

Dr. Denmark, in the fourth volume of the Medico-Chirurgical Transactions, relates the case of a man who had a small tumour in the arm, which followed an injury by a musket ball, and which produced very violent symptoms, and was cured by amputation of the arm.

On dissecting the arm, Dr. Denmark observes, that the median nerve seemed to be blended with, and intimately attached to the wounded parts for the space of an inch. It had been wounded, and at the place of the injury was thickened to twice its natural diameter, and seemed as if contracted in length. This contraction, he says, I thought partly accounted for the bent position of the arm, and the increased pain in attempting its extension;

* Cours d'Anatomie Medicale par Antoine Portal, tom. iv. p. 247.

but on further examination, he goes on to say, I was surprised to find on dividing the fibres in the posterior part of the wounded nerve, that there was a small portion of ball firmly embedded in it. The nerve was evidently thickened, both above and below the wound. At the conclusion of the case Dr. Denmark puts the following question:—Would the division of the nerve, and cutting a piece of it out, have been attended with success?

From the experience of surgeons, cutting out a piece of a nerve does not seem to be attended with any bad symptoms, as is particularly shown in the case related by Mr. Abernethy, who cut out a portion of the digital nerve; and likewise in that* related by Sir Everard Home, where there was a tumour in the musculo-cutaneous nerve, and three inches of it were removed by Mr. Hunter. The objections made to this process in Dr. Denmark's case were the contraction of the elbow, together with the injured state of the arm. Now it appears to me, that as there was not any such injury of the arm as would have prevented its cure, and its being afterwards very useful, I think when such cases as this occur, the

* Transactions of a Society for promoting Medical and Chirurgical Knowledge, vol. ii. p. 154.

diseased part of the nerve ought to be removed. If its being blended with, and intimately attached to the surrounding parts should prevent its removal with safety, might not it be divided above and below, and a small portion at each place be removed; and thus, by insulating the diseased parts, all the unpleasant symptoms be got the better of; but if it be possible the diseased part itself ought by all means to be removed. In the seventeenth case, which I shall presently relate, where a nerve was wounded in venesection, every attempt to straighten the arm produced the same pain as in this case. I consider this case as being very similar to that related by Sir Everard Home, where the tumour was removed from the musculo-cutaneous nerve by Mr. Hunter, and in all probability it would have been attended with the same happy result, had the portion of nerve been cut out. In either this case, or the above-mentioned one related by Sir Everard Home, there did not appear to be any constitutional disorder of the nervous system, as in the twenty-first case which I shall relate in course, and in cases similar to those two of Dr. Denmark and Sir Everard Home, I do not think the nerves of any persons, under such circumstances, would

be sufficiently void of irritability, to let the extraneous bodies (for such the tumour in the nerve might be called, as well as the bit of ball in Dr. Denmark's case) remain without producing the same symptoms.

From the experiments I have made on animals, it appears, that the nerves may be either divided, or a portion of them removed without any other injury to the animal, than the paralysis of the parts to which they were distributed; and as it has been ascertained by different surgeons, that a part of a nerve may be removed in the human subject without producing any untoward symptoms, as far as the constitution is concerned, I think whenever any disease is seated in a nerve, as a tumour, &c. it would generally be much better to remove a portion of the nerve, with the disease, than to cause much disturbance in separating the portions of nerve in order to extricate the tumour. The case* related by Sir Everard Home, of the removal of a tumour from one of the axillary nerves, terminated fatally; and whether the result would have been different had a portion of nerve been removed with it, I will not venture to conjecture. Should, how-

* Transactions of a Society for promoting Medical and Chirurgical Knowledge, vol. ii. p. 157.

ever, a disease be situated in the sciatic nerve, as a tumour, &c. if it be confined to that part of it which eventually forms the popliteal nerve, and the fibular is not implicated in the disease, I would separate the latter, as I think it can be done without disturbing or much irritating any part of the nervous substance, and keep it entire, if it should be necessary to take out a portion of the main trunk. Cutting out a portion of the whole sciatic nerve would render a limb entirely useless, and expose it to serious injuries from cold, &c; but if the fibular is left entire, the patient will not only have some use of the limb, but the bad effect of cold, &c. will be in a great degree prevented.

When a nerve has been divided, reunion in course of time generally becomes perfectly established, so that it performs its functions as well as if no division had ever taken place. When a portion of a nerve has been removed, and especially if it be a large portion, the breach is with the greatest difficulty, if ever repaired, when it happens in the case of a nerve of the largest size. For instance, when a portion of the sciatic nerve has been removed, the separation of the divided extremities is very extensive, the superior portion prepares for the reunion by an increased vascu-

larity; but though the inferior does so likewise, it is in a much less degree; and after a time this vascularity is very greatly diminished, and the restorative process appears at a stand. The reason why there is this backwardness of the inferior portion, is the want of that action which the influence of the brain and spinal marrow imparts to the limb above, and which it is now prevented from imparting to the limb below the place where the nerve was divided. This circumstance shews in a marked degree the influence the nerves have over the action of the blood-vessels, and consequently over the secretion of coagulable lymph. In every simple division of a nerve, the inferior portion always exhibited a striking difference in the experiments I made on animals. Chasms in almost every other part of the body are generally filled up, when the blood-vessels surrounding them are perfect; but in this instance, though scarcely a vessel is wounded, the fact is otherwise, shewing the great influence the nerves exercise in every part and action of the animal economy.

As far as I can judge from experiments, and the few cases dispersed through the medical records, I think when there is a choice between simply dividing and removing a por-

tion of a large nerve, the former ought always to be preferred. For though we know that a portion of a nerve may be removed without injury to the constitution; yet when we look at the very great inconvenience the removal of a portion of a large nerve occasions in the parts to which it is distributed, I think it can hardly be advisable that this should be done, when there is a chance of relieving the patient by a simple division. But when the disease is in one of the smaller nerves, as a digital nerve, or one of the cutaneous nerves, I think no hesitation would be required about the removal of a portion of such a nerve, because it can interfere in so very small a degree with the functions of the part; and in such cases a mere division, not having much power over the action of the blood-vessels, is too easily repaired, as is shewn frequently in tic douloureux; so that a portion of such nerves as these may be removed, not only without any bad effect, but with advantage.

As, therefore, when a portion of a large nerve has been removed, it is replaced with so much difficulty, whenever a nerve is diseased which supplies parts that are of much importance, it will deserve the most serious consideration of the surgeon to determine on the

best method of proceeding. When a limb is supplied, or nearly so, by one nerve only, as the leg is by the sciatic nerve, it would require great caution before the removal of part of it is practised. On the contrary, in the nerves of the upper extremity, the same doubts about the propriety of removing a part would not exist, at least to so great a degree, owing to the numerous sources from which the parts are supplied with nervous influence; because here the functions of the limb, as far as its preservation and its more general use are concerned, would not be much impaired; though at the same time it must be observed, that the parts which constitute the sense of touch, and the finer movements of the hand, would undoubtedly be much injured by the removal of a portion of the principal nerve, as the median. Whenever it is determined that a portion of a nerve shall be removed, it ought to be as small a one as possible. Should, however, the disease, as a tumour, be such as to occupy a large portion of the sciatic nerve, and the peroneal could not be saved, if the tumour were so situated that it might be dissected out of the nerve, would its removal in this way be advisable? If not, what will be the most effectual method of relieving the patient, who is threat-

ened with death from the continued violent pain. In the before-mentioned case of tumour in the axillary nerve, as related by Sir Everard Home, the patient had the use of the parts after the operation, but he died. In one view, therefore, there were advantages gained over the removal of a portion of the nerve, though the operation seems to have been the cause of the patient's death. Sir Everard says, " that in examining the parts after death, the tumour was found to have been incased in one of the large nerves which forms the axillary plexus: the principal substance of the nerve passed along the posterior surface of the tumour. The cyst was now much contracted, and more than four times thicker than at the time of the operation. In consequence of having been inflamed, the cavity was lined with coagulated lymph, and almost filled with coagulated blood, as suppuration had not completely taken place. The inflammation and swelling had extended some way into the surrounding parts, which were also consolidated into one mass, and with difficulty separated by dissection. The other parts of the body were found in a natural state, so that there was no evident cause of death, but what arose from a considerable degree of inflammation upon the substance of a large

nerve, for three inches in length, which also affected the other nerves of the plexus."

"In the removal of such tumours we find, that so far as we are justified in drawing conclusions from two instances, the taking away three inches of a nerve is productive of less violent effects, than are occasioned by inflammation and suppuration in the substance of the nerve for an equal extent."

But whether this would have been the same in a nerve in a different situation, I am not prepared to say. In this case there were several circumstances to produce more violent symptoms, in consequence of the inflammation which would succeed to such an operation, and which might not be expected to so great a degree in the nerves of another part. For, first of all, there was a tumour in another nerve, which would in all probability tend to make the parts more irritable than they otherwise would have been; and then the axilla is so much occupied by loose cellular membrane, and absorbent vessels and glands, so largely supplied with blood-vessels, and the diseased part, in this case, so much surrounded by nerves, as to create a difference in the circumstances here, from almost every other part of the body.

In some nerves the tumour is so intermixed with the nervous fibrils as to make its removal impossible, without at the same time cutting away a portion of the nerve, as must have been done in the case* related by Mr. Charles Bell; here, therefore, there is no alternative, but the portion of nerve must be removed along with it. I cannot conceive that a mere division of the nerve above the tumour would be ever advisable, for though it would most probably free the patient from suffering for a time, yet it would be only for a time, as I think the pain would most assuredly return when the reunion of the divided nerves had taken place, unless there were an absorption of the tumour, which I do not consider as by any means probable. But with regard to the case before supposed, where a tumour occupies several inches of the sciatic nerve, I should be inclined either to dissect it out, or amputate the limb, if the peroneal nerve could not be preserved entire. Mr. Guthrie† says, "if a cannon-shot strike the back of the thigh and carry away the muscular parts behind, and with it the great sciatic nerve, amputation is necessary, even if the bone be untouched; for although the wound

* Operative Surgery, vol. ii. p. 161.

† Observations on Gun-shot Wounds, p. 185.

might in some measure heal, the motion of the leg would be lost, and it would become an insupportable burthen to the patient."

I conceive that this would not be the only inconvenience attending a destruction of the nerve, but that the patient would be very liable to extensive mortifications from slight accidents, as has been very frequently experienced in horses that have been nerved, when the foot has mortified and come entirely off, and the horse has died in consequence.

CHAP. IX.

OF INJURIES OF THE NERVES OF VOLUNTARY MOTION, &c.

The symptoms occasioned by injuries of the nerves are frequently very violent, but they are so various as to make it impossible to say what will be the result of an accident that has affected them, as sometimes an apparently trifling injury of them will bring on bad symptoms, whilst at another time a more violent one will not be attended by a single untoward symptom.

CHAP. X.

ON THE TREATMENT OF DIVIDED NERVES.

When a nerve has been divided, if the external wound is healed by the first intention, very little pain is felt in the nerve, in proof of which I shall relate the following case.

Case 15.

Mr. C. fell with his hands on a bottle, and cut both his thumbs. The wounds were situated across the thumbs, and very near the junctions of the metacarpal bone with the first phalanx. In one of them the nerve, which I distinctly saw, was completely divided. He felt much pain before the wounds were dressed. I examined them well, to be certain that no glass was in them, and then closed them with interrupted sutures, sticking plaster, and a bandage.

He suffered no pain in them at any time after I dressed them, and they soon healed.

Both thumbs beyond the wound were quite benumbed, and for a length of time after, the cold had a very great effect on them; sensation however kept gradually returning; and though it is now nearly a year since the accident, it is not quite perfect.

An open ulcer connected with a wounded nerve is generally very painful, and sometimes produces violent symptoms; so that when a nerve has been divided, it is a matter of the greatest importance to produce union of the parts about it by the first intention, because then the divided extremities of the nerves are not irritated, being excluded from the air, and from every thing that could communicate irritation to them; and they have then only the action necessary for their reparation to support. It is necessary to clear away as much as possible all the coagulated blood that may have been effused, and every thing that can act as an extraneous body. It seldom happened in any of the rabbits, on which I made the experiments hereinafter detailed, that any inflammation was produced, and all the wounds in almost every one of them healed by the first intention. But in one case, where much blood was effused, the external wound appeared more open, and the nerve inflamed to a greater extent

than when no coagulated blood was present.

Whenever it is possible, the edges of the wound should be united with straps of sticking plaster; but when the situation of the part is such as not to admit of the application of the plaster, the interrupted suture should be employed. When, however, the wound has been in a cutaneous nerve, I should prefer doing all I could to bring the edges of the wound together with the plaster, though in an apparently more imperfect manner, rather than run the risk of irritating the nerves of the skin through which the ligature would pass, and most probably in passing, come in contact with some of the fibrils of the affected nerve.

When a nerve has been divided, and the external wound has healed, and there are marks of inflammation about the cicatrix, as a slight redness, tumefaction, and tenderness on pressure, it frequently happens that this inflammation is communicated to the nerve and causes great pain, which is generally aggravated by any motion of the part.

The best method of treatment will be to apply leeches near the parts, and evaporating lotions, and to keep them constantly at rest.

I need not say how necessary it is in all

diseases to pay proper attention to the state of the digestive organs, and that it is so most especially in all diseases and injuries of the nerves.

When a nerve has been divided, and the wound does not heal by the first intention, but inflames, violent pain and frequently spasms are produced from a communication of the inflammation to the nerve.

If the patient has much fever, and is of a robust constitution, some blood should be taken from the arm. Sudorifies should then be given with as much opium as will allay the irritation, and fomentations and poultices should be applied to the parts.

In this case the wound must in general heal by granulations, and until these have proceeded so far as to exclude the nerve from the external air, and the influence of the parts about it, it will be liable to produce much irritation.

It has been shewn by Mr. Hunter, that a wound or breach of any part made internally, may heal by granulations without causing any secretion of pus. This process I have seen in the healing of a divided nerve in a dog, and it did not seem to suffer pain, I should suppose, from the wound in the muscles having healed by the first intention.

From the experiments I have made, there appear to be two modes which nature employs for effecting the union of divided nerves; one by the effusion of coagulable lymph, the other by granulations; and of the latter there are two kinds, one where there is a secretion of pus, the other where there is none. Neither the union by the effusion of coagulable lymph, nor that by granulations, so long as there is an exclusion from the air and from every thing that can produce a greater action than is just necessary for the restorative process, cause much irritation or pain.

When nerves are connected with external wounds, they granulate like other parts, as I once saw in the leg of a boy that was amputated some time after a compound fracture, when the soft parts were in a state of ulceration. In the experiments I have made, though the result has been nearly the same in all of them, yet in some few instances nature has been backward in carrying the restorative process to that degree of perfection she usually does. And even when experiments have been made on both the hind legs of the same rabbit, on its being killed, the divided nerves in the two limbs have now and then had very different appearances; in one the healing process has

been going on as it ought to do, in the other hardly any attempts have been made to begin it; that increased vascularity of the parts has been wanting which usually takes place, and consequently there has been a want of the deposit of coagulable lymph; and thus I conceive it may be in the human subject, where in some instances the union never properly takes place, as the patients are ever after either deprived of sensation, &c. or exposed to unpleasant effects from cold, &c. in the parts beyond the divided nerve.

When a nerve has been accidentally divided, if the external wound has healed, and there has not been any symptom of irritation for some time, in order to expedite the restoration of the nerve, it may be advisable to rub the part well daily with the hand, or a flesh brush; and in order to stimulate it still further the following embrocation may be used:

℞ Linim. sapon. comp. ʒx.
Liquoris ammoniæ ʒij. *m.*

from time to time the quantity of the liquor ammoniæ may be increased. Should this plan be ineffectual, I think it probable, that galvanism daily applied to the part, might give the stimulus necessary for increasing the action of

the parts, and thereby enable them to complete the union of the divided nerve.

Under these circumstances nature will be assisted by exercise, a generous diet, with a proper quantity of wine, and by doing every thing that can invigorate the constitution.

That this backwardness in nature to effect the union is owing to a want of action, is proved by its always happening when healthy nerves have been accidentally divided, and its seldom occurring in those affected by tic douloureux, where we know the action of the parts is always increased.

In the following case the sciatic nerve was wounded by a fracture of the thigh bone, an accident, I think, not very unfrequently happening in consequence of fractures of the bones, though it has hitherto been very little noticed. There are other points worthy of notice in this case, and, though unconnected with the subject of this dissertation, as they may lead to observations that may be useful, I shall briefly notice them.

Case 16.

John Wright, about seventy years of age, got a fall about the beginning of May, and injured the left hip. I saw him for the first time

on the first of June. The knee and foot were turned completely inwards; and if this position of the limb was changed, it was always soon resumed: the thigh could be raised by an assistant towards the abdomen as high as usual, but could not be rotated much: the limb was shortened about an inch: the trochanter major was not far from its usual situation, but behind it there was a rounded tumour, which was apparent, and could be distinctly felt, so as to convey the exact resemblance of the head of the thigh bone: when the hand was placed about the trochanter, and the limb was moved, a crepitus could be felt: the limb had the exact appearance of the dislocation backwards. He complained of very violent pain for some time, much more than is usual; but for the last two or three weeks he lay in an almost insensible state: he was in a very debilitated state before the accident, but after it he never had any appetite; so that he sunk from complete exhaustion on the twenty-fourth of June.

The next morning I examined the part where the injury was received.

On dividing the integuments, a small quantity of a dark-coloured fluid escaped: all the parts for some distance appeared one confused

mass, from the quantity of coagulated extravasated blood. The thigh bone was broken through below the capsular ligament, and another portion was broken off below this, in an oblique direction, so as to leave the trochanter major nearly perfect; this portion lay behind the trochanter, and when covered by the integuments had a rounded feel like the head of the bone: another small portion was likewise completely detached. All the portions of bone were surrounded by coagulated blood, which appeared to have become organized, for in several parts of it were found osseous deposits: the head of the bone appeared inflamed, and was coated with coagulable lymph. Nearly all the cartilage lining the acetabulum was absorbed.

The sciatic nerve was much enlarged, and likewise surrounded by coagulated blood; and in one place a portion of coagulum, about the size of a filbert, adhered very firmly to it; and when it was examined, portions of a whitish substance might very distinctly be seen in it, so as to convey the idea of this part having taken on the structure of newly-formed nerve: at this part some nervous fibrils had been lacerated.

The appearances of the limb in this case

were different from what are usually presented in fractures of the neck of the thigh bone; and were such, that (without great care) might have been mistaken for a dislocation of the bone backwards. The wound of the nerve sufficiently accounted for the violent pain. Had this case been mistaken, how greatly must the patient's sufferings have been aggravated, as much extension of the limb would in all probability have inflicted another injury on the nerve, as well as all the other parts.

CHAP. XI.

OF THE TREATMENT OF PUNCTURES, OR PARTIAL DIVISIONS OF NERVES.

It may always be concluded, that a nerve has been injured, if upon the infliction of the wound, very acute pain is complained of, and especially if it is in the situation of a nerve; but what will make it still more probable, will be the extension of the pain in the course of the nerve, and convulsions, or other symptoms of great nervous irritation accompanying it, which it is frequently difficult, and sometimes impossible to appease by any remedies. Frequently the pain will be very acute only at the moment the wound is inflicted; sometimes it will continue for a while, and keep gradually abating, so that the patient will be easy sometimes for three or four days, and then the pain will begin again, and go on gradually increasing until it is as severe as at the first infliction of the wound, when in some cases all the

symptoms I have noticed, as accompanying a wounded nerve, will appear: sometimes the symptoms will continue violent from the first.

Some have supposed that an injury of a nerve in venesection is always owing to a partial division of a nerve, and that in order to a cure, it is necessary for the nerve to be wholly divided. That it is so sometimes, I shall relate a case to prove; but that it is not always so, will appear from the following case.

Case 17.

A woman, about forty years of age, got a fall, which shook her head very much, and for which I bled her from the cephalic vein: she felt no inconvenience for two or three days, but after that her arm became painful from the shoulder to the wrist, and she seemed to suffer very much.

There was a little thickening about the cicatrix, and it was painful when touched. I ordered some extract of belladonna to be applied to it. Some days after when I saw her, the cicatrix was quite even and soft, and might be pinched without producing pain. The pain now only struck upwards to the neck whenever she attempted to straighten her arm. I

ordered her arm and neck to be bathed with the following liniment, and the pain gradually wore off, though it was some weeks in doing so.

℞ Linim. Carb. Amm. ʒvj.
Tinct. Opii. ʒij. Mf. Linim.

In the following case, for which I am obliged to my friend Dr. Wilson, of Grantham, the symptoms were the most violent that can happen from a wound of a nerve, except those of tetanus; and I think there is very little doubt, that if the nerve had not been divided above the place where the injury was received, the case would have terminated in the patient's death.

Case 18.

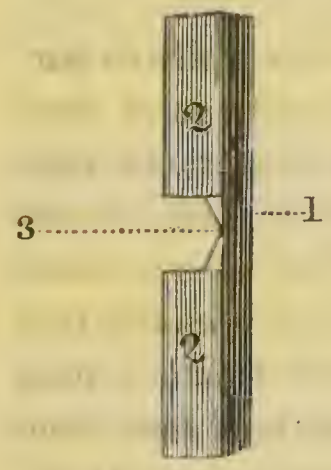
I was desired to visit Mr. B.'s housekeeper, at ——. I found my patient in strong convulsions, and held upon the bed by several assistants; her hands were strongly clenched, and she was struggling greatly: she soon after became comatose. I was informed that she had been let blood two days before by a gardener; that she complained very much of the arm where she was bled, and of a pain shooting from thence to the shoulder. I examined

the orifice of bleeding, which was in the median vein; it had not healed, was somewhat inflamed, and a thin liquor oozed from the lips of the wound. While I was making this examination she became again strongly convulsed, as I supposed, from the irritation I had caused. With a view to interrupt the communication from the diseased point to the sensorium, I applied a tourniquet above the part: a remission of the spasms soon followed, and I administered an anodyne; but the convulsions after a short interval of ease recurred as before, and the application of the tourniquet was again made without any good effect. As I had no doubt that the cause of the disorder was an injury of a cutaneous nerve in the operation of venesection, I determined to endeavour, by a transverse incision, to divide the nerve above the injured part, and to destroy its connexion with the sensorium; I therefore made an incision while the convulsions were most violent, of about an inch in length and small depth just above the orifice: no mitigation of symptoms was perceived; but on making another incision above the former one, somewhat deeper and longer, she cried out immediately, to the astonishment of the attendants, "I am well, I am quite well, I can stir my arm;"

which she began to move, and continued to do so with great delight for some time in various ways. She had no return of the spasms, and very soon got well.

When a nerve has been wholly divided, each portion of it immediately retracts, so that a considerable space is left between them. When only a partial division has taken place, the divided portions retract in the same manner, though not in so great a degree, leaving a space in the divided part of the nerve, whilst the undivided portion remains of the same length as before the division. Now each nerve, or at least the greatest part of them, is composed of different fasciculi, and these fasciculi in most instances, communicate together: should one complete fasciculus be divided, that had not any communications with the others of which the nerve is composed, it would retract, and leave its fellows in the same state as before the division, and it is most probable that there would be no other difference, as from irritation, &c. than when the nerve is completely divided; but if a fasciculus is partially divided, or if it is wholly divided, and at the point of division it was connected with the adjoining fasciculus, the retraction of the divided parts would stretch those that were joined to it, and

thereby cause considerable pain; for we know that this stretching of a nerve produces violent symptoms, as in cases of tumour. I will endeavour to explain my meaning by the following:



1 Undivided portion of nerve.
2 2 Divided portions.
3 Two fibrils by which the divided and undivided portions communicated, and which, by the retraction of the divided portions, must be kept on the stretch.

But again, should a nerve be wholly divided, except one fasciculus, and at this place there were not many communications, the great retraction of the divided parts would very much keep on the stretch the undivided fasciculus. Any one may be satisfied of this by taking an animal soon after it is killed, and laying bare a nerve, and almost entirely dividing it; the divided portions will be seen to have retracted in some degree, but immediately on dividing the remaining part, each

end of the nerve will retract in the quickest possible manner to a much greater distance than it did before the undivided part was cut through; thereby clearly proving, that as there was nothing but this small portion to prevent the retraction, it must have been kept very much on the stretch.

From the experiments I have made in partially dividing the nerves of animals, it does not appear to me that they suffer more than when a nerve has been wholly divided; nevertheless, in a partial division, the nerve is under such circumstances, as to make it probable that the irritation would be greater than in a total division. I cannot help thinking, that from the variety of accidents which are perpetually happening, as well as in the performance of surgical operations, nerves must be frequently pricked or partially divided, and yet how seldom does it happen that we observe the symptoms characteristic of a wounded nerve.

Whether a wound of a nerve in the human subject, and in other animals, differs in the symptoms it produces, cannot be determined; nor is it easy to say whether by the nerves of the human subject being connected with the mind, which has so much influence over the body, any material difference is produced

with respect to the functions of the nerves; but I think it probable some such difference may exist, when we see that this connexion does influence many parts of the body under diseases; and if it does other parts, we may suppose it would the nerves themselves, by which the mind and body are connected. But if there be really no difference between the functions of the nerves of man and other animals, there seems no other way of accounting for the violent effects which follow the wound of a nerve in the human species, than by supposing either that they must be affected in a manner as to the form of the wound, &c. different from what we are acquainted with, or that the wound must have been inflicted in persons of peculiar constitutions, or that after its infliction the parts must have undergone some change that would produce such alarming symptoms. I have endeavoured to shew how a partial division of a nerve may produce the violent symptoms. It may be that whilst the nerve is free from inflammation, and the action necessary for its healing is only present, this peculiar wound may not cause much irritation; but that when it becomes inflamed, the fibres that are on the stretch may begin to feel acutely. We know that there is a very

great difference between the sensations, occasioned by the healing process when the external wound heals by the first intention, and no greater action is present than is just required for effecting the union of a divided nerve, and when, on the contrary, the external wound keeps open, and the ends of the nerve are exposed to inflammation; and may not a nerve, when there has been a partial division, heal under the same unirritating action, if the form of the wound is not particularly unfavourable, and the patient not of a very irritable constitution?

But to shew that the wound of a nerve may be the entire and immediate cause of the symptoms, independent of inflammation, or any thing else that could irritate the nerve, the following case* of wounded nerve from bleeding in the foot, related by Sabatier, will prove, as in this instance, they must have been owing to the peculiar form of the wound.

"This slight operation," he says, "was very painful, and was soon followed by convulsive motions, which extended themselves through the whole of the wounded extremity, and then

* De la Medecine Operatoire, par M. Sabatier, tom. i. p. 253.

through the rest of the body: these symptoms were not accompanied by any tumefaction, and were very often renewed. The patient could neither walk, nor ride in a carriage. This state having continued a long time, notwithstanding the use of antispasmodics and quieting remedies, I advised a division of the saphenus nerve, but it was not consented to; nevertheless the nervous symptoms gradually diminished, and the patient partly recovered her health, after five or six years almost continual suffering."

When a patient complains of pain immediately after bleeding, and this increases, I should be afraid that the symptoms will continue until the wound of the nerve has healed; but should he complain of acute pain at the time of bleeding, and feel no more pain for a few days, I should expect that though the nerve had been injured, it would have healed without causing any irritation, had not the arm been used, and inflammation produced in consequence; and I should expect when this inflammation was removed, that the healing process would go on in the same unirritating manner it did before the inflammation: I should, therefore, if I again meet with cases of injured nerve from bleeding, apply several

leeches in the neighbourhood of the part, and then evaporating lotions; and should these disagree, I should try a fomentation of poppies and poultices, at the same time I should have the limb kept quiet, and in the most easy position.

I have very little doubt but by far the greatest number of injured nerves in venesection are made troublesome by the patient using the arm too soon, and bringing on inflammation; for I have never seen an instance of any bad consequences from bleeding, where a patient has been so ill as to be unable to do any thing.

Whenever a person has complained of very acute pain on the opening of a vein, great care ought to be taken to close the wound well with a linen compress and bandage, which should be watched so as to be kept continually on the orifice, and the arm should be confined in a sling until the wound is perfectly healed.

I relate the following case to shew that if a nerve is wounded in bleeding, and the external wound heals by the first intention, the wound of the nerve will not generally be of much consequence.

Case 19.

I bled Mrs. D. in the median cephalic vein; she complained of very acute pain at the time I made the puncture, and it continued for several hours.

As I was certain from the manner in which she complained that I had wounded a nerve, I was very careful in binding up the arm well, so as to keep the lips of the wound in exact contact, and at the same time told her of the necessity there was for keeping her arm entirely at rest. The wound healed by the first intention, and the pain did not return.

Shortly after writing the above pages the following case occurred to me.

Case 20.

J. H. aged twenty, was bled in the median cephalic vein of the left arm for a pain in his head; he felt the infliction of the wound acutely, but afterwards did not complain of it, and he continued to move his arm as usual.

On the third day he began to complain of pain in it; the wound was not quite healed, and was rather inflamed, but there was no swelling about the arm.

On the fourth day the pain had increased,

and there was a tenderness in the skin to some distance on the outside of the wound: the pain struck up to the shoulder, and down the arm to the back of the hand.

On the fifth day the wound was inflamed, and the pain in the arm had increased, but it was confined to the same parts: there was more tenderness on the skin on the outside of the wound, but there was neither inflammation nor swelling: There never was any pain in pressing the ulnar side, or that portion of skin that forms the inner lip of the wound: there were no symptoms of inflammation either of the absorbents or veins; and there was no tenderness, pain, or swelling in the course of the brachial artery, or in the axilla, but the pain went up on the outside of the biceps muscle to the shoulder: moving the arm always increased the pain.

On the fifth day four leeches were applied about the wound, which gave almost immediate relief; and then cloths made wet with a saturnine lotion were kept constantly applied.

On the sixth day he continued easier, but the pain was reproduced by moving the arm; after this it kept gradually abating, and in a few days quite left him.

It appeared to me, that in this case there was a small branch of the external cutaneous nerve wounded, which became inflamed in consequence of a too free use of the arm.

From experiments in animals, it appears that in whatever way wounds of the nerves are made, they are repaired by nature alone. It becomes then necessary to inquire under what circumstances the interference of a surgeon is requisite, when the nerves have been injured in the human species.

In bleeding, it is undoubtedly proved that the nerves sometimes suffer from a wound by the lancet; in many instances there have been violent symptoms, but in course of time these have subsided: it is therefore right when this accident has happened to wait for a while, and try by palliatives to assuage the violence of the pain and other symptoms that may occur. But if the irritation be so great that convulsions have come on, as in the eighteenth case, and threaten the patient's life, a similar operation should be attempted, in order to cut off the communication between the brain and wounded nerve; and here therefore the assistance of a surgeon will be absolutely necessary.

To illustrate this subject still further, I

shall introduce extracts from two cases related by Larrey*; as the parts there mentioned, though not concerned in venesection, appear to have been in a nearly similar state.

The first was that of a man who was struck by a ball, which crossed the right arm, and wounded the biceps and coraco-brachialis muscles, and the radial and internal cutaneous nerves. On the eighth day he began to have great pain; and it was wished to divide a bridge left by the wound, in which were found some branches of the internal cutaneous nerve, but the patient refused to have it done. The next day his local pains were very acute; he had convulsive motions of the hand and fore arm, heat in the whole system, and locked jaw; he was very restless, and in continual agitation. The rapid progress of the symptoms determined Larrey to divide the bridge, and cut the bottom of the wound, where he found several nervous bridles. This operation was very painful; but two hours afterwards the patient was much relieved, and in the space of two days all the symptoms disappeared.

The second was that of a man who received

* Memoires de Chirurgie Militaire, vol. i. p. 269, and vol. iii. p. 307.

an injury from a spear on the right side of the forehead. The point of the spear had slided obliquely from below upwards and inwards under the pericranium, so as to make a deep fissure in the frontal bone: one of the superciliary nerves was grazed by the cutting side of the spear.

Nine days passed without any alarming symptoms, and it was considered as a simple wound; but in the night between the ninth and tenth days tetanus came on, with convulsive motions of the corresponding eye-lids, and a loss of sight in that eye: there was a little mental wandering, a very acute pain, locked jaw, and a very marked disposition to emprosthotonos.

Emollients were immediately applied to the wound, and diaphoretic and opiate draughts were given without effect; the complaints went on increasing, and in twenty-four hours would have been at their greatest height. The wound was then examined with a probe, which gave very acute pain; this determined Larrey to divide from below upwards with a bistoury the whole of the superciliary muscle, the nerves, and vessels: the patient was immediately relieved, and in less than twenty-four hours all the tetanic symptoms had disappeared.

As the following case* seems to throw additional light on the subject of wounded nerves, I shall relate it.

"A young man of a very healthy and robust constitution, received a stab near the knee at the inferior and inner part of the left thigh, in the course of the saphena vein and nerve. The bleeding from the wound was with difficulty stopped; swelling came on, and fever; the affected extremity was very painful. When these first symptoms had abated, a trembling of the leg and thigh was perceived, which was at first slight, but afterwards violent; all attempts at remedying this were in vain; the patient had not a moment's repose. I judged," says M. Sabatier, "that the saphena vein and nerve had been affected, and to prove this to the patient, I passed a sword across the inferior part of the thigh of a subject, at the place where the young man had been wounded, and as much as I could in the direction, the one with which he had been stabbed, had taken. The saphena vein was found entirely divided, and the nerve cut half through. I insisted on the use of the cautery, but the young man was too irresolute to consent to it.

* De la Medecine Operatoire, par M. Sabatier, tom. i. p. 254.

I did not see him again for more than six months after, when I met him walking in the street with the assistance of a stick; he said that he had used a milk diet, and that his complaint had almost entirely left him. There remained still sufficient sensibility to prevent his riding in a carriage without much pain. He was feeble, but endeavoured to use as much exercise as was possible. By degrees he recovered his good health, and has enjoyed a long time his accustomed strength."

The above interesting case shews a great similarity of symptoms to those related in the eighteenth case, though they do not appear to have been quite so violent. But though in this case they spontaneously abated, and the patient got quite well, yet I think it would not be advisable to trust altogether to the natural efforts of the constitution in similar cases. The eighteenth case shews, that in all probability if an operation had not been attempted, and the patient had survived the symptoms that threatened her life, she might have undergone continual suffering for many months, or even years; and though, as in Sabatier's case, these might have subsided on the complete cicatrization of the wounded nerve, yet we cannot be certain that there will be this fa-

vourable event, for the violent symptoms occasioned by the wound of a nerve, are in many cases continued long after the time has elapsed that was necessary for its healing. Of this we have a strong instance in the following case.

Case 21.

Mrs. E. about forty years of age, reeeived a cut on the inside of the first phalanx of the left thumb. Immediately after the accident she felt a numbness in the arm, and a sense of fullness as if the skin would burst; these sensations continued for a fortnight, and the wound healed very well. At the end of this time violent pain came on, when a tremulous motion could be seen in the part which it occupied. The pain was termed startings, or spasms, by the patient, and was felt in different ways, but the muscles were not affected. These spasms were felt all over the body, though they were by far the most frequent in the upper half of it. She frequently felt a great heat in the chest and abdomen, but most partieularly in the latter, and the same startings as in other parts of the body. The sensations were sometimes as if the flesh was pinched with hot irons; sometimes a great heat, as if

hot water was poured down her back; sometimes she had frequent shakings of the whole body, which were unattended by pain, and were most relieved by drinking hot water. The spasms were not confined to the left arm, but she had them at the same time in the right, and frequently in the right when she had none in the left. The forefinger was as painful as the thumb, and if any thing touched either of them, the spasms were produced, which continued many days. She had a good appetite; her bowels were confined, and her tongue furred, but she had no thirst.

Electricity was tried, as were likewise several topical applications, but they gave no relief. She took a great variety of medicines, but none but the extractum cicutæ and the following mixture seemed to render her any material service.

℞ Camphoræ, ℈i.
Mucilaginis Acaciæ, ℥ss.
Spirit. Ætheris Sulph.
Syrupi aa. ℥ij.
Aq. puræ, ℥vij.
Tinct. Hyoscyami, ℥iss. Mf.
Mist. cap. coch. iij. pro re natâ.

In the state I have described she continued

about six months, after which the spasms were less frequent; but if the thumb or forefinger were touched or moved at any time, the spasms were reproduced. Every year since she has been much better than in the preceding one; but though it is now nearly seven years since the accident, and she is seldom affected by the spasms, yet that extreme susceptibility of any impression still remains in the thumb; and though the feeling in the forefinger is much less acute than formerly, yet it has not entirely recovered its natural state.

In this case no operation was attempted, for the spasms were so general, and appeared so much blended with the constitution, that it was thought that any fresh wound inflicted might produce serious mischief, and it was very doubtful whether the division of the nerve could do any good.

During the greatest part of the time since the accident her appetite has continued good, and she has always been allowed a generous diet, which, indeed, in the generality of these cases, the great expenditure of the nervous power renders absolutely necessary.

To shew how generally her constitution is still affected from slight causes, only a few weeks before I wrote this, the mere carrying

of an umbrella two hours, produced sensations all over the body, as if needles were running into her, restlessness, pain at the stomach, and head-ach, and it was two or three days before these symptoms went off.

Lifting a weight, or using the right arm much, always produces sensations as if needles were running into it; and attempting to use the fingers of the left hand, as in knitting, produces giddiness.

In such a case as this, what is most advisable to be done? Should the nerve near the wound be cut down upon, and a portion of it removed? I should myself be afraid of performing such an operation in such a subject, until from more experience we have satisfactory reason for believing that the general nervous affection does not proceed from the constitution, but the nerve itself; and that worse symptoms will not be produced by an operation. Till this can be ascertained, and until it shall decidedly appear, as in a case related by Mr. Wardrop, that the constitution is merely sympathizing with the injured nerve, and that the violent affection of the nerve does not proceed from the peculiarity of the constitution, I should think the attempt too hazardous to be made. In a case where the constitution

is so generally affected, it seems to me that we should wait, and try by palliatives to obviate the distressing symptoms; and if we find, as in this case, there is a progress towards amendment, though ever so slow, we ought to rest satisfied, rather than run the risk of an operation, the performance of which after all might possibly aggravate, instead of lessening the disorder. In confirmation of this method of proceeding, I will add the following observations * of Mr. Pearson, which I think are very applicable to this subject.

"When no deviation from the natural condition of the part can be detected by the most able and accurate examination, and when parts at a distance from the immediate seat of the pain sympathize on every accession of the paroxysm, there is ground for presuming that the source of the malady resides in some other portion of the nervous system, and that the division of the nerve in the part whence the pain seems to originate, may prove rather injurious than beneficial. This unfavourable issue of a successful operation is not an assumption founded on mere reasoning or analogy; cases have occurred where the patient

* Medico-Chirurgical Transactions, vol. viii.

has not only been disappointed of relief, but the irritation has been transferred subsequently to the spinal marrow and brain."

When, however, the disease has lasted a long time, and nothing has afforded relief, and the constitution is suffering very much from the irritation, the division, or the cutting out of a portion of the nerve ought to be tried, or the amputation of the part where the injury was received. I have heard of amputation of the thumb having proved successful in one of those cases, where the nervous symptoms proceeded from a wound: it has also been successful in Mr. Wardrop's case, where the disease originated in the finger. The loss of a thumb is a very serious one, but when we consider that it is of no use in its present state, and set against the loss the agony which the patient would otherwise continue to endure if the removal of part of the nerve has not succeeded, I think the probable advantage of being freed from pain, and consequent injury of the constitution, may reasonably be looked upon as compensating for the loss. Should the disease be in a finger, less hesitation about its amputation would be necessary. When it is in a large nerve of the upper or lower extremity, and a question arises whether

the limb should be amputated, or a portion of the nerve removed, the latter, I think, ought always to be done, except under very particular circumstances.

Punctured wounds of the fingers frequently cause very alarming symptoms, which I cannot but suppose are owing to the puncture of one of the nervous fibrils, which are so numerous in these parts. They cannot be owing to a mere wound, because if the wound is enlarged, and a bit of caustic is cut so as to have a sharp point, and is introduced into it, the pain generally subsides, and all the alarming symptoms go off.

Query: Whether in this case the caustic does not destroy the remaining part of the wounded fibril, and thereby remove the symptoms?

In a case, related by Mr. Wardrop in the eighth volume of the Medico-Chirurgical Transactions, of a woman who had pricked the fore finger of her right hand with a gooseberry thorn, the two first phalanges were very painful, and so acutely sensible as not endure being touched. After having suffered very much for twelve months, the finger was amputated, and she got completely well.

It has generally been supposed these pain-

ful nervous affections are connected with, and dependent on a disordered state of the digestive organs; and that they are very frequently so cannot, I think, be doubted; but that this is not always the fact, is proved by Mr. Wardrop's case, of which, as it is different from what is generally supposed in similar cases, I shall transcribe the following paragraphs.

"The nervous paroxysms usually attacked her two or three times a day, and one of them always came on at the time of her rising out of bed. During these attacks the pain extended along the finger to the back of the hand, and between the two bones of the fore arm, darted through the elbow joint, stretched up the back of the arm to the neck and head, producing a sensation at the roots of the hairs as if they had become erect. To these feelings succeeded a dimness of sight, and the pain afterwards went suddenly into the stomach, followed by sickness and vomiting. She had constantly the feeling of a lump at her stomach, and always vomited after taking food or drink. Her flesh too was much wasted, and she had become extremely pale.

"No sooner had she got into bed after the operation, than she experienced a remarkable difference in her feelings; the sensation of a

lump in the stomach, and sickness which she had so long felt immediately subsided; and in half an hour after the operation, she said she felt for the first time, as well as she had done previous to the accident, except merely a slight pain in the stump."

I have related cases where the spasms, if they might be so called, were those tremors that are frequently present in tic douloureux. In some instances where a nerve is injured, the muscles are excited so as to produce spasms of them to a very great degree, and sometimes convulsions; as in the case I have already related, arising from an injury of a nerve in venesection.

In these cases, if by soothing applications to the injured part, and palliatives, as the administration of opium and other antispasmodies, and attention to the state of the constitution, the symptoms do not abate, I should recommend cutting out a portion of the nerve near the place where the injury was received. When every thing else has failed, and the spasms always begin in the muscles of one part, and then seize the others of the same limb, if they can be stopped at the part they generally first seize by applying any thing tight, as a tourniquet, round the limb, should cutting out

a portion of the nerve at the injured part prove unsuccessful, might not paralyzing the muscles where the spasms first begin, by dividing the nerve that is distributed to them, have the effect of preventing the spasms, and thus cure the patient?

Mr. Pearson says*, "during the course of many years practice, several cases of the local affection of a nerve or nerves, accompanied by muscular spasms, had occurred, and had often proved very untractable. I was at length induced to attempt the cure of these painful complaints by inflicting a disease, which should extend over a large portion of the surface of the body, and which, after exciting a series of actions in the skin, should finally cause an extensive eruption, attended with the usual concomitants of certain exanthemata." For this purpose he recommends the following liniment to be rubbed twice or three times a day on part of the skin, until an eruption is produced.

℞ Olei Olivæ, ℥ijß.
—— Terebinthinæ, ℥iß.
Acidi Sulphurici, ʒi. M.

He further says, "In one of these cases, where the arm and hand of a young lady had

* Medico-Chirurgical Transactions, vol. viii.

become nearly useless, and the symptoms had been combated by all the usual remedies in vain during twelve months, the patient was cured by the application of the liniment, which excited a considerable tumefaction of the whole arm, with a vesicular eruption. It was necessary in this case to produce the cutaneous disease three times, at intervals of about a week, and it never extended beyond the upper extremity."

The same in effect, but more violent in degree, are those spasms of the muscles produced by injuries of the nerves, and constituting the disease termed tetanus. It comes on generally about the ninth day after an accident, though the time of its attack varies; but what is the most unaccountable, it comes on when there appears no reason for it, and frequently from very slight wounds.

In this country it rarely occurs as an idiopathic complaint, though I have seen one instance of this kind; but in warm climates it frequently comes on without any previous injury, from cold, &c.

Before its coming on there is a general uneasiness and restlessness; sometimes the wound becomes painful and inflamed, and the discharge of pus entirely ceases. After these

symptoms, its approach is usually marked by a stiffness about the neek, and difficulty of deglutition; then there is pain and diffieulty in moving the lower jaw. These symptoms keep increasing, sometimes very gradually, and sometimes beeoming violent in a few hours, producing very great contractions of most of the voluntary muscles, whieh are attended with very excrueiating pain. These eontinue to return in some subjeets with great frequency, and generally destroy the patient in the first three or four days. When the spasms are less violent, and only confined to the jaw, the patients will frequently reeover.

The cause of the disease is a violent irritation of the nerves, produeed either by the suppression of perspiration, as when it eomes on from cold, or from an irritation of the nerves of a wound, either where the large nerves have been injured, or where their more minute branehes are irritated from the unhealthy aetion in the wound. Larrey* relates three cases where it was produced by an injury of the larger nerves. In the first, the anterior erural and sciatie nerves had been injured by a ball; in the second, the median

* Memoires de Chirurgie Militaire, tom. iii. p. 290.

nerve had been tied with the brachial artery; and in the third, the nerves had been tied in amputation of the leg.

Some have supposed that this complaint proceeds from some disease in the parts about the medulla spinalis. That changes from the healthy appearance have been found in the membranes of the medulla spinalis in some cases of this kind there can be no doubt; but whether they are consequences of the violent contractions of the muscles, or accidental occurrences, cannot, I think, be determined: at all events, I should hardly be inclined to think that the changes in these parts can have been the causes of the disease.

The method of treatment, that has been found the most effectual, is the administration of laudanum or opium in large and repeated doses, and at the same time strong purgatives. A liberal use of wine. The pulvis ipecacuanhæ compositus given in doses of ten grains every four hours, has been found of much service. Occasionally other remedies have succeeded, as the cold bath, turpentine clysters, &c. But though what I have said has been considered the most effectual mode of treatment, yet it must be confessed, that we cannot depend upon any of these remedies.

When a patient who has been wounded, from going on well, becomes restless, and the appearance of the wound suddenly alters, and becomes inflamed, and the secretion of matter is diminished, fomentations of poppies, and poultices, should be applied to it; a sufficient dose of opium to allay the irritation should be given, and with it several grains of the submuriate of mercury, and the patient should be purged as soon as possible. If no relief is obtained by these means, and the symptoms seem to increase, a blister may be applied to the wound, which has been found effectual* in taking off the irritation, and restoring the secretion of pus. Besides blisters, Larrey has found that incisions of the wound, and the application of the actual cautery, where the nerves are suffering, have removed the tetanic symptoms; and he relates one case where amputation of the limb has caused them to disappear, and has thereby saved the patient's life.

This, as well as many other diseases of the nervous system, opens a wide field for inquiry; and I doubt not but at some future period, if organic disease of the medulla spinalis is not

* Memoires de Chirurgie Militaire, tom. iii. p. 297.

found to be the predisposing cause, a method of treating these cases will be discovered, that may in a great degree be relied on for their cure.

CHAP. XII.

ON THE EFFECTS OF LIGATURES ON NERVES.

MANY experiments have been made on animals to shew the effects which a ligature applied on a nerve has on the parts to which it is distributed; but they do not shew much respecting the changes the nerve itself undergoes, or the diseases the ligature might occasion.

It has been ascertained that the effects of ligatures on the constitution are always hazardous; for though many such cases have terminated favourably, yet more frequently death has been the consequence. Knowing this, it might be thought, that as the application of ligatures on nerves is so little to be recommended, it could answer very little purpose to make experiments to ascertain their effects; but as they are sometimes put on accidentally, and it is frequently not found out until violent symptoms and even death have

ensued, I thought it right to inquire what changes are produced by them, and to see whether it could be known when this accident has happened, and whether any thing could be done for the prevention of fatal consequences when they are threatened. When it is supposed, by the complaints of violent pain, a ligature has been applied on a nerve, should the symptoms denoting tetanus, or a termination of life come on, the ligature must if possible be removed. Larrey* has done this with advantage in cases threatened with tetanus.

The manner in which he recommends the ligature to be cut away, when a nerve and artery have been included in it, is to pass a grooved stylet carefully between the artery and the ligature, and pass a blade of a very fine and small pair of scissors in the groove of the stylet, and divide the thread. Should one of the larger nerves have been tied by itself in a stump, and tetanic symptoms are coming on, the ligature ought by all means to be removed.

To ascertain exactly whether a ligature has been put on a nerve will sometimes be difficult; but if the following circumstances are

* Memoires de Chirurgie Militaire, tom. iii. p. 294.

attended to, I think it may be generally discovered.

When a nerve is much irritated, the pain produced by it is in general referred to the parts to which it is distributed. After amputating the leg of William Sharpe, as related in the twelfth case, the fibular nerve projected an inch from the stump, which I thought it better to remove, and in doing this he referred the pain to the outside of the leg. In a case of tumour formed in the sciatic nerve from a ligature, the pain was generally referred to the extremity of the foot. In the case of tumour in the sciatic nerve, related by Mr. Charles Bell, the same complaints were made; and I think when patients refer the pain to parts which they did not complain of before the operation, it is most probable that the nerve which was distributed to them is in a great state of irritation, and that a ligature may have been fixed on it. If there is sufficient reason for supposing this to be the case, I think it may be further ascertained by taking hold of the several ligatures that have been used in the operation, and pulling them in the gentlest manner; and if the doing of this to one in particular should aggravate the pain already complained of, and tetanus, or other very alarming symp-

toms are approaching, by which the patient is in danger of being destroyed, it ought to be removed at all hazards.

In my opinion ligatures ought not to be put on nerves for any purpose, as it can be very seldom necessary to employ them; and if there be an apparent necessity, as was done by Mr. Hunter, in a case related by Sir Everard Home, after he had removed a tumour from the musculo-cutaneous nerve, still, I think, every other method should first be tried, before so dangerous an expedient is resorted to. In any other case it never could be necessary, than when there is a profuse hemorrhage, and then, I think, the vessel may generally be tied; but should it happen as it did in the operation * performed by Mr. Hunter, that the vessel cannot be secured without including the nerve in the ligature, would not the actual cautery be preferable?

When, however, the application of a ligature is decided upon, it ought to be fine, and strong enough to allow of being drawn so tight as to completely strangulate the part of the nerve on which it is applied, for then the nerve is brought nearly to the same state as

* Sir Everard Home's paper in the Transactions of a Society for promoting Medical and Chirurgical Knowledge.

when it has been simply divided. On the contrary, if the ligature were coarse, it would occasion greater irritation in the wound, and consequently in the nerve, and thereby increase the danger to the patient. And unless the nerve were so firmly compressed by the ligature as to prevent all communication of sensation, and likewise circulation of blood between the two portions of nerve, the ligature would cause such an enlargement of both its extremities by the irritation it would create, and would be with such difficulty dislodged, that if the patient should not suffer extremely at the time, it would most probably cause the formation of a tumour, producing so much pain as gradually to wear out his strength.

Larrey* relates the cases of two patients who died of tetanus: in one, where the arm was amputated, and the median nerve had been included in a ligature with the humeral artery; the portion of nerve below the ligature was swelled out like a mushroom, and that above was much enlarged and of a reddish colour. In the other, nineteen days after the amputation of the leg, the extremities of the nerves were swoln in the same manner, and

* Memoires de Chirurgie Militaire, tom. iii. p. 290.

adhering to the surrounding parts. Portal* relates a case, where this tumour formed above a ligature that was put on the sciatic nerve after amputation of the leg. The patient had suffered horrible pains for more than two years, which he always referred to the end of the foot; and after death this tumour was found.

* Cours d'Anatomie Medicale, tom. iv. p. 289.

CHAP. XIII.

ON THE COMPRESSION OF NERVES.

When a nerve is pressed against a bone for a short time, an uneasy sensation is produced, and the parts to which it is distributed feel benumbed. When the pressure is continued longer, these parts entirely lose the power both of sensation and motion; but if it has not been very violent they will recover. Two cases of this kind are related by Richerand*.

"A young man went to sleep with his head resting on his arm, the outside of which was placed on the edge of a table, so as to compress the radial nerve, and the consequence was an insensibility of part of the integuments, and a paralysis of the muscles at the back part of the fore arm. These symptoms were removed by irritating frictions in the course of the nerve."

* Nisographie Chirurgicale, tom. ii. p. 204.

"Compression of the median nerve during an operation that was performed on the fore arm, produced a numbness of the limb; the sensibility was not restored before the end of forty-eight hours."

When the nerves have been injured from a continued pressure, the best remedy will be frequent frictions of the hand, and the use of a stimulating embrocation, such as the following.

℞ Linim. Sapon. Comp. ʒx.
Liquoris Ammoniæ, ʒij. M.

Pain is frequently felt in a part from pressure made on the origin of the nerve that supplies it: this frequently takes place in the course of the sciatic nerve, and sometimes of the anterior crural, from pressure on their origins within the pelvis. I have seen cases of this kind where purging has given great relief, where it arose from the sigmoid flexure of the colon and rectum being loaded with fœces.

A very curious case* of this kind is related by Portal, the subject of which was a woman who had a very great curvature of the spine, and three or four hours after each meal com-

* Cours d'Anatomie Medicale, tom. iv. p. 276.

plained of much pain in the great toe of the left foot: it was always increased by injections, but went off when she had a copious alvine evacuation. It was found to have been produced by pressure made by the last false ribs on the sigmoid flexure of the colon, which caused the fœces to have great difficulty in passing, and in consequence compressed the lumbar plexus of nerves.

I introduce the following case, because it shews that when there has been a paraplegia, that it is not merely of consequence to draw off the urine on account of the safety of the bladder, but because its over-distension presses on the nerves, and must tend to prevent their recovery. This idea forcibly struck me the first time I used the catheter for the patient who is the subject of the case. The bladder was very much distended, and urine kept constantly running from the penis. The distension of the bladder caused much uneasiness; but immediately after I had drawn off two quarts of urine, the lower extremities were more sensible, and that tingling was felt in them, which is known to every one who has been in a position to press the sciatic nerve, and has experienced the sensation that arises when the pressure is removed; and I conceive

that such repeated pressure on the nerves, which are already very much enfeebled, must tend very materially to retard, if not to prevent their restoration. I introduce this case likewise because it serves to illustrate the theory I have advanced in the former part of this dissertation.

Case 22.

Nov. 6, 1819. Mr. F. aged twenty-five, had the heart-burn, after which he ate a hearty dinner of beef and apple dumpling, and the heart-burn went off. Soon after he carried a weight of wood for some distance, which produced the heart-burn again, and he was obliged to lie down on the damp ground from feeling so unwell. After he had laid a little while his legs began to feel weak, and he had much difficulty in walking home, as the powers of the muscles kept diminishing, and at last they en-entirely failed. The bladder, and also the sphincter ani, lost almost entirely their muscular power: the paralysis extended from the pit of the stomach downwards: he had no power of moving any of the muscles: he felt well, except being thirsty, and had a good appetite: when the bladder was very much distended he felt pain, but it was not violent: the feel-

ing of the skin was so far perfect as to render him sensible of the slightest touch; but moderately cold things applied to the skin did not feel cold, nor did hot things feel more than just warm: his sensations of heat and cold with the upper extremities were perfect, and very different from those experienced by the lower.

The symptoms in this case are slighter than those usually met with where pressure is made on the medulla spinalis, as in fractures of the spine; and, I think, prove beyond all doubt, that the nerves have all the same degree of feeling, but that the various agents that call them into action act in a more easy or difficult manner. The sense of touch is by far the most mechanical; moderate degrees of heat and cold are less active agents; and the will still less.

The catheter was generally used twice every day, from the seventh of November to the second of December; after this he expelled his urine without its assistance, but he had not the power of holding it a moment after the inclination to make it came on for several months.

As the secretions of the digestive organs were unhealthy, he took five grains of the

blue pill every night for some time, and tonic medicines.

Large sloughs formed on the sacrum and hips, and the sores formed by their separation were many months before they healed; and the discharge was so great, that he was in danger of sinking under it, notwithstanding he had a good appetite, and a very generous diet was allowed him.

He began to have some little power over the muscles about a month after they became paralytic, but he was kept so weak by the discharge from the sores, that it was not till the beginning of March that he could exert them much; he then began to walk by the help of crutches, and at the end of April he could walk with sticks, but his legs still continued weak. At the beginning of June he could walk for a short distance without any assistance, but he generally used one stick.

Sometimes the nerves suffer so much from a sudden compression as to lose entirely their power, which they have the greatest difficulty of recovering. Portal* relates a case of this kind, where a child fell from a great height on the pavement on her buttocks, but particularly

* Cours d'Anatomie Medicale, tom. iv. p. 297.

on her left; she could not raise herself, and experienced violent pain. The inferior extremity immediately became insensible, and wasted away, notwithstanding she had every attention paid in administering the remedies, which had been prescribed by the most able physicians.

The same accident happens sometimes to the nerves of the axillary plexus from an injury of the shoulder, as in the following case.

Case 23.

March 25. A lady, about sixty years of age, fell from some height and hurt her right shoulder, and was likewise bruised in other parts. I saw her the day after the accident, and found her complaining very much of her head and shoulder: no injury was perceived about the former part, but in the latter I discovered that the portion of the bone that forms the glenoid cavity of the scapula had been broken; she complained very much of pain in it, which struck to the neck and down to the fingers, and was very severe about the elbow: her fore arm and hand were nearly paralytic. I bled her, and gave her purging medicines, which entirely relieved her head; a plaster was applied to her shoulder, which was supported by a bandage and sling.

Any motion of the shoulder always gave her pain, and for a long time produced violent eructations of wind from the stomach; but every week seemed to restore it, and at the end of eleven it was so much recovered that no grating could be felt in moving it, which was the case at first; and the arm could be moved freely backwards and forwards without pain, though it could not be lifted very far from the side without considerable pain. She was allowed to use it now as much as she pleased; and as the fore arm and hand had very little sensation, friction of the whole limb was used, and likewise the following embrocation.

℞ Spirit. Vini Tenuis, ℥ijß.
Liquoris Ammoniæ, ℥ß. M.

After this she continued to improve, having had much more use of her hand, and the whole arm could be raised much further from the side, and none of the eructations were produced by the motion as before.

I had hitherto supposed, that as she had always been subject to a pain in the head, and was rather of a full habit, she had fallen down in a slight fit of apoplexy, and the paralytic affection of the arm was the consequence; but

on the 24th of July, on her arm being suddenly, and rather violently moved, very great pain was immediately produced: I examined the limb soon after, but could not discover that any injury had been done to the bone; but all her former symptoms returned, and the limb was brought back to the state it was in many weeks before, for the pain was much increased on moving it, which also produced the eructations; the power of raising it from the side was lessened, and the paralytic affection of the hand much increased. I had now no doubt but that at the first accident the nerves of the axillary plexus had been much injured, and that from this injury the paralysis proceeded, as all the same nervous symptoms were reproduced after the second injury, and without any affection of the head. After this last accident she continued the friction of the arm, and the parts kept gradually recovering, but they were not arrived at the state they were in before it happened. At the end of September a blister was applied across the clavicle, so as to extend from the shoulder some way up the neck: this seemed to remove much of the pain, and the limb seemed to be gradually, though very slowly, recovering. From this time it continued in every

respect to improve, and in May, 1820, the patient had the almost entirely perfect use of it.

A nerve may be extended some way without giving pain or uneasiness, as I have frequently observed in making experiments, when I have passed a probe under the sciatic nerve and drawn it from its situation; and as is shewn in cases of popliteal aneurism, when the swelling may get to some size before much pain is produced.

But when a nerve is extended in any considerable degree, pain is excited; and if the extension is increased, the pain is increased in proportion, till at length the nerve begins to ulcerate, and if the pressure is not removed, is almost entirely destroyed.

Violent blows on the back sometimes cause bad symptoms, though they are unattended by much apparent external injury, as in the following case.

Case 24.

A man, about thirty years of age, fell from a waggon on his back: he immediately had violent pain in his back, with convulsions of its muscles, attended with most excruciating pain; for a minute or two he would be com-

paratively easy, and then the convulsions would return with great violence. He was bled, took a large dose of laudanum, and a mixture with sulphate of magnesia dissolved in peppermint water, to which some æther was added: his back was frequently fomented and rubbed with an anodyne liniment. The pain continued in this way violent for about twelve hours, and then gradually abated: at the end of twenty-four hours he had passed no urine, and as the bladder was very much distended, and he had much pain from it, his water was drawn off: he continued after this to expel his urine whenever he pleased: the pain kept gradually diminishing, and in about a week all symptoms of complaint, except general weakness, left him.

In this instance the accident could only have produced a violent irritation of the nerves, as the patient so soon got well, and never ailed any thing more.

Symptoms of the like kind, though more violent in degree, are sometimes produced by an accident of this sort, when a permanent injury either of the medulla spinalis or its nerves is inflicted, so as to paralyze all the parts below the place where the injury is done; and though they will after a length of time recover, yet they

are never perfectly restored to the state they were in before the accident.

I relate the following case, because it shews that after an injury of the medulla spinalis, the nerves may be sufficiently restored to be capable of performing their functions so as to produce feeling, when they are not so in the least degree for the production of voluntary motion; and likewise because it shews that when the medulla has not been too much injured, if every compressing power is removed, a very great degree of restoration may be effected.

Case 25.

September 14, 1819. Joseph Morris, of Willoughton, aged thirty-three, whilst on the ground had his head forced violently forward by three men; he immediately became insensible, and as it was supposed that his neck was dislocated, a man immediately held him fast between his knees, and having his hands fixed under the lower jaw, drew up the head forcibly, and the patient became immediately sensible; but a most serious injury was found to have been inflicted on the medulla spinalis, for all the parts below the neck were paralytic, but the right side was so the most completely; all sensation, as well as motion of that side was

lost; and on the left side he could just tell when he was touched, but the feeling was imperfect.

The patient gave this account of himself: Mr. Barton of Market Raisin saw him the next day, but found it impossible to obtain any satisfactory information respecting the manner in which the accident happened from any of the persons about him. He found him lying with his head extended backwards beyond the pillow, which only supported the back of the neck; he placed the head in a more comfortable position, for the patient had not the power of moving it himself; this gave him some pain about the lowest cervical vertebra: there was then a considerable and extensive tumefaction about this part, and a paralytic state of the body, and fever. Venesection, and aperient medicines, very much relieved him. When the tumefaction had subsided, Mr. Barton examined the spine, without finding any distortion of it: pain and increased numbness were occasioned by certain movements of the arms, and by deep lateral pressure on the vertebra, and it appeared to him that there was a fracture connected with the right transverse process.

At the end of January, 1820, he was ad-

mitted into the County Hospital. I saw him for the first time on the fifth of February; he then had the perfect feeling in every part of the body, except the extremities of the thumbs and fingers, which felt very numb: the muscles below the injury were as completely paralytic as they ever had been, but he could distinguish whatever touched him: he complained of a pain in his head, which had continued ever since the accident; he complained likewise of a very great pain in the right shoulder: there was some enlargement and tenderness on pressure about the last cervical vertebra: he appeared in good health as far as the functions of the viscera were concerned.

I despaired of rendering him any essential service; but as there was an enlargement of the vertebra, I made a seton on each side of it. Soon after the setons began to discharge he had some power over the muscles. At the end of the month he could just stand by himself, and walk when a person supported him, so as to keep him steady: he had some use of the left arm, but very little of the right.

April 1. The pain in the head has entirely left him; he can walk tolerably well by himself, and can raise his left arm to some height, but he cannot raise his right, though he can

move them both, backwards and forwards. When attempts are made to raise the arms, the soft parts appear stiff, and considerable pain is produced in them, and a numbness. The setons have been removed, as all the enlargement and tenderness about the vertebra had disappeared. He was ordered to have both his arms rubbed well daily with the linimentum ammoniæ, and to have them frequently moved.

He was discharged from the hospital on the fifth of June, with the perfect use of the lower extremities, so much so as to be enabled to walk to a considerable distance. The use of his arms was much improved since the beginning of April, and he was entirely free from pain when they were moved. He was in perfect health; and I doubt not but that from the gradually progressive manner in which he has continued towards amendment from the time the setons began to discharge, that the use of the upper extremities will increase, so as to enable him to work again.

To go on with this subject, I must relate all the injuries and diseases to which the medulla spinalis is liable; but though this undoubtedly forms a part of the nervous system, yet as I do not conceive its injuries and dis-

eases were intended to be comprised in the question before me, any more than those of the brain, I shall pass them over without farther observation.

CHAP. XIV.

AN EXPERIMENTAL INQUIRY INTO THE PROCESS NATURE EMPLOYS FOR REPAIRING WOUNDS OF NERVES.

MANY experiments have been made by physiologists, to prove that when a nerve is divided, all sensation and motion are lost in the parts to which it was distributed, and that after the reunion of the divided parts it performs its functions as well as before the division. I had always understood that this was a point generally agreed upon by physiologists; and it has been so well illustrated, especially by the experiments of Dr. Haighton, that it is difficult to conceive how, after an elucidation so satisfactory, any doubt should remain on the question; but when we find it contradicted by several eminent men, so much hesitation is produced in the minds of those who are unbiassed by any favourite hypothesis, as to lead them to make an experimental inquiry into the subject for themselves.

Richerand* says, "Myself a dupe to these pretended regenerations of nerves, I have repeated, without success, the experiments of Haighton." He further says†, "That this paralysis, produced by the entire section of the nerve, either with or without a loss of substance, is incurable."

Delpech‡ says, "The section of a nerve causes a paralysis of the limb to which it is distributed. Observation teaches us, that when a trunk or principal branch of a nerve is affected, the paralysis which results from the section is incurable; and experience has taught us, that the reunion is effected by means of an intermediate fibrous substance, totally different from the nervous structure, and incapable of performing the functions for which these organs are destined."

Amidst these contradictions, as I was not aware that any experiments had been instituted to shew the process nature adopts for the restoration of the parts, and as I could not obtain from books knowledge sufficiently satisfactory, I have made the following experi-

* Nosographie Chirurgicale, tom. ii. p. 210.

† Ibid. tom. ii. p. 207.

‡ Precis Elementaire des Maladies Reputees Chirurgicales, tom. i. p. 175.

ments, which I trust will account for many things respecting injured nerves, which surgeons do not at present seem clear about.

EXPERIMENT I.

July 6th, in the left leg of a rabbit the sciatic nerve was exposed, one blade of a pair of scissors carried under it, and it was divided at one cut.

July 7th, twenty-four hours after, that of the right leg was divided in the same way.

July 8th, the rabbit was killed twenty-four hours after the division of the last nerve. In the right leg the wound in the skin was perfectly united, that where the muscles were separated was quite open, and there was not any inflammation about the wound. On examining the nerve, the inferior portion was separated from the superior three-quarters of an inch, and a small portion of it was doubled down on itself: some coagulable lymph, which had very much the appearance of white of egg, was about it. The extremity was enlarged so as to form a bulb, which became very distinct when examined in a microscope, and appeared rather more vascular than the rest of the

nerve. The extremity of the superior portion was covered with coagulable lymph for about a quarter of an inch; the very extremity itself was enlarged, so as to have the appearance of a bulb, or rather two bulbs, one for the sciatic nerve, and the other for the fibular nerve; and this extremity of the nerve was very vascular, much more so than the inferior portion, and the nerve was altogether more vascular than in its sound state.

On examining the nerve of the left leg, forty-eight hours after its division, the inferior part had a small portion doubled down as in the right leg: it was covered with coagulable lymph for some distance. The extremity of this portion was much more enlarged and more vascular than the corresponding portion in the right leg; and, by the aid of a microscope, vessels were seen shooting into the coagulable lymph. This portion was separated from the superior a quarter of an inch.

The superior portion was much larger than in the corresponding portion of the right leg, and was covered with much more coagulable lymph, which had become very vascular. It was enlarged to only a very short distance, and had some slight adhesions to the muscles.

EXPERIMENT II.

July 6th, the sciatic nerve in the left leg of another rabbit was divided, and on the 8th that of the right leg was divided, and the rabbit was killed on the 11th.

In the right leg, seventy-two hours after the division, the divided portions of nerve were separated from each other half an inch. The inferior portion had no part doubled, as in the preceding experiment. More coagulable lymph was effused than in the preceding experiment, and it had become much more vascular. In the superior portion there was likewise much more coagulable lymph than in the preceding experiment; it was also much more vascular, and the vessels in the nerve for three-quarters of an inch were much increased in size, and the nerve itself enlarged.

In the left leg, one hundred and twenty hours after the nerve had been divided, the two portions were not separated more than a quarter of an inch from each other, and the space was entirely filled up with coagulable lymph, so as to join both portions together, so much so, that when the nerve was removed from the limb, and one end was taken hold of,

the other seemed firmly united to it: the vessels in the nerve itself were less numerous, and not so large as in the right leg. The coagulable lymph throughout its whole extent was quite vascular. When the skin was separated, there was a very small portion of matter and some coagulable lymph between the skin and muscles; but the wound in the muscles was closed, and did not seem to have any mark of inflammation about it.

EXPERIMENT III.

The sciatic nerve of the left leg of a rabbit was divided July 9th, that of the right was divided July 15th, and the rabbit was killed July 23d.

In the left leg, fourteen days after the division, the extremities of both portions of nerve were enlarged, and were not separated more than a quarter of an inch; and this space was filled up with coagulable lymph, which had become organized, but had a browner appearance than is usual. The wound in the skin and muscles was perfectly healed.

In the right leg, eight days after the division of the nerve, the divided portions were

separated six-and-a-half-twelfths of an inch; their extremities were somewhat enlarged, but not vascular, and a very little attempt at union seemed to have been made. The wound in the skin and muscles was perfectly healed.

The rabbit appeared to be in good health.

EXPERIMENT IV.

July 16th, both sciatic nerves of a rabbit were divided, and it was killed on the 28th.

In the right leg, the divided portions of nerve were separated from each other four-and-a-half-twelfths of an inch, and the space was filled up with organized coagulable lymph. The extremity of the superior portion was much enlarged, and that of the inferior very little.

In the left leg, the divided portions were separated the same distance as in the right, and the extremities of both the portions were more enlarged than in the right leg, and the superior more than the inferior. The adhesions between the portions were firm, and the quantity of coagulable lymph was greater than in the other leg.

There was a considerable arterial hemorrhage in both legs when the nerves were divided.

When the animal was killed, the wounds in the skin and muscles were perfectly healed, and there was no appearance of extravasated blood about the nerve.

EXPERIMENT V.

The sciatic nerve was divided June 9th, and the rabbit was killed July 14th.

The extremities of the divided portions were perfectly united, but remained larger than the rest of the nerve. The bond of union was more transparent than the rest of the nerve, and was two-twelfths of an inch long; when held up to the light, the extremities of the nerve might be seen in it.

EXPERIMENT VI.

The sciatic nerve of one of the legs was divided July 9th, and the other on the 15th, and the rabbit was killed Sept. 27th.

They were both perfectly reunited, and the

rabbit was much improved in the use of its legs.

EXPERIMENT VII.

The sciatic nerve was divided July 16th, and the rabbit was killed August 10th.

The size of coagulable lymph was very large, and had a cavity, which contained a substance like brain.

I consider this as an accidental occurrence, having seen similar collections of this substance in cysts in different parts of several rabbits, and when there had not been any injury. The substance was very much like what I have seen in fungus hæmatodes in the human subject, and very different from the pus I have seen usually secreted in rabbits.

EXPERIMENT VIII.

The sciatic nerve of the right leg of a rabbit was divided July 17th, and it was killed Nov. 22d.

Observations made on Sept. 11th. It could make much use of its leg. From this time it

kept gradually improving, and before it was killed it had nearly the perfect use of the limb.

On examination, the nerve was enlarged to some distance, where it had been divided, and appeared perfectly united. There had been a slight ulceration of the integuments of the heel soon after the division of the nerve, but it had healed, and the foot was in every respect perfect.

EXPERIMENT IX.

July 12th, the sciatic nerve was exposed, and partially divided with a pair of scissors, and the rabbit was killed twenty-four hours after.

On examination, it was found that a small portion of the nerve had been divided, and that the divided parts had retracted from each other to a short distance; their extremities were rather enlarged, and had the same appearance as the nerve* had that was entirely divided twenty-four hours before it was exa-

* See Experiment 1.

mined, except that there was rather more vascularity in the nerve of this experiment.

EXPERIMENT X.

July 12th, the sciatic nerve was partially divided in the same way, and the rabbit killed forty-six hours after.

On examination, a branch which lies close to the nerve, and arises from it high up in the thigh, was completely divided, and its extremities were separated two-twelfths of an inch, and each extremity was enlarged. Part of the trunk of the nerve was also divided, and the extremities of the divided portion were separated a very short distance, and were both enlarged, and there were the same appearances as in a total division of the nerve.

EXPERIMENT XI.

July 13th, the whole of the sciatic nerve was divided, except that part which forms the fibular nerve, and the rabbit was killed July 16th, seventy-two hours after.

On examination, the extremities of the di-

vided portion were separated four-twelfths of an inch, and were enlarged; coagulable lymph was effused on them, and likewise on the undivided portion, and vessels were seen in it.

EXPERIMENT XII.

The sciatic nerve of the left leg was partially divided, and the rabbit was killed one hundred and thirty-four hours after.

On examining the nerve, it was found that one fasciculus of it had been divided, the extremities of the divided portion were separated one twenty-fourth part of an inch, and the space was filled up with coagulable lymph, some of which was likewise effused on the surrounding part of the nerve, and there was a greater vascularity there than in the other parts of the nerve.

The sciatic nerve of the right leg of the same rabbit, was punctured at the same time with a lancet.

On examination, a small vacuity was perceived, and about it there was a slight enlargement, and a greater vascularity than in the other parts; and some coagulable lymph

was effused, both on the nerve, and in the vacuity made by the puncture.

EXPERIMENT XIII.

The sciatic nerve was partially divided on the eleventh of June, and the rabbit was killed on the sixteenth of July.

On examination, the wound in the nerve was perfectly healed, and at that part was very much enlarged for half an inch, and had the same appearance as when a nerve had been wholly divided, and has been allowed the same length of time for its reunion.

In all these experiments of partially dividing the nerve, the external wound was closed in the same way as when the nerve had been wholly divided; and immediately after the experiments the rabbits seemed to have the least possible inconvenience in walking, even in that where the whole nerve, except the fibular portion, was divided; and I could not perceive that they suffered more than those whose nerves had been wholly divided: they always seemed in good health, and ate their food well.

All the above experiments were made on rabbits, as they are on every account the most convenient for the purpose; but as the object of these experiments was important, and I thought it possible, as these animals lived entirely on farinaceous substances and vegetables, their nerves might on that account be affected by injuries in a different way from other animals, who at the same time eat flesh, I made the two following experiments on a dog, but did not find that there were any peculiar symptoms produced by them.

EXPERIMENT XIV.

July 14th, I partially divided the left sciatic nerve of a dog, which was killed on the second of August.

Very little lameness was produced by it. Two-thirds of the wound in the skin were healed, and the wound in the muscles was quite healed; the wound in the nerve was likewise quite healed, having been filled up with coagulable lymph, which was completely organized. The extremities of the divided portions were enlarged.

After this experiment the dog did not ap-

pear to suffer much; he had always a good appetite, and certainly got fat during the time I had him.

EXPERIMENT XV.

The sciatic nerve of the right leg of the same dog was completely divided on the twenty-sixth of July.

Part of the wound of the skin had healed by the first intention, the remainder continued open, and was filling up by granulations. The wound in the muscles was perfectly healed. The extremities of the divided portions of nerve were separated two-and-a-half-twelfths of an inch, and were both much enlarged. On the posterior part of the nerve, or that which lies nearest the bone, the space was filled up, and was white and transparent. On the anterior part it was quite uneven, and appeared as if healing by granulations, but there was no discharge of pus.

The cellular membrane about the nerve was thickened to some distance.

EXPERIMENT XVI.

June 10th, the sciatic nerve of the right leg was divided, and the rabbit killed on the twenty-first of August.

Both extremities of the divided portion were enlarged, and separated from each other five-twelfths of an inch: the attempts at union were very little.

Half an inch of the sciatic nerve of the left leg of the same rabbit was cut out on the twenty-fourth of July.

The extremities of the divided portions were separated nine-and-a-half-twelfths of an inch; from the upper, four-twelfths of an inch had grown of the substance that becomes new nerve, and from the inferior, three-twelfths.

EXPERIMENT XVII.

Half an inch of the sciatic nerve of the right leg of a rabbit was cut out on the tenth of June, and it was killed on the twenty-sixth of July.

The extremities of the divided portions

were separated, except by a membrane, seven-twelfths of an inch. From the superior a quarter of an inch of new nerve had grown, and the inferior was very much enlarged.

The wound in the skin and muscles was perfectly healed.

Half an inch of the left sciatic nerve of the same rabbit was cut out on the twenty-fourth of July.

On examination forty-eight hours after, the extremities of the divided portions were separated eleven-twelfths of an inch. Much blood was effused about the nerve. Neither the external wound nor that of the muscles was closed. The extremity of the inferior portion was enlarged and vascular, and some coagulable lymph had been effused, as when there has been merely a division; that of the superior portion was very vascular, and more inflamed to a greater distance than is usual, and was covered with coagulable lymph, as in a total division. There was more inflammation about the wound than in any other experiment.

EXPERIMENT XVIII.

Half an inch of the sciatic nerve of the left leg was cut out on the sixteenth of July, and the rabbit was killed on the twenty-second of November.

The extremities of the divided portions were separated from each other eight-twelfths of an inch. There appeared several small branches arising from the superior portion, but there were three in particular *, one of which is always continued down to the outside of the heel, but in this case was larger than ordinary: the other two appeared to be newly-formed nerves; one went from the superior portion to the popliteal nerve, the other went from the same place to that which corresponds with the fibular nerve in the human subject.

The integuments of the heel were in an ulcerated state, and part of the os calcis was dead; but these diseased appearances had not I think increased in the last two months. The rabbit was certainly much improved in the use of the limb, but it was very far from being perfect.

* See Plate II.

EXPERIMENT XIX.

August 7th, the sciatic nerve of the right leg of a rabbit was tied with a ligature of thread as tight as possible, and the rabbit was killed on the tenth, seventy-two hours after.

On examination, the wound in the skin and muscles was quite healed, except just at the place where the ligature came out.

Much coagulable lymph was effused about the nerve at the place where the ligature was, and more than in the case of a simple division.

On removing the ligature, the nerve appeared divided, but the portions were not at all separated, as when there had been a division made with a cutting instrument. The coagulable lymph effused by each portion appeared to have united, and to be very vascular, and the vessels of each portion to have communicated with each other. The nerve was rather more inflamed, and to a greater distance, than when there has been a division by a cutting instrument. The limb was more irritable than I had ever observed in any other experiment. Involuntary contractions of the muscles of the leg and thigh continued for a

quarter of an hour after it was killed, and ten minutes after I removed the sciatic nerve from the limb.

EXPERIMENT XX.

Both the sciatic nerves of a rabbit were tied with a thick ligature on the twelfth of August, and the rabbit was killed on the sixth of September.

That of the right leg was merely tied, and not divided. The wound in the skin and muscles was entirely healed; and though the ligature was not separated, and it came out at the skin, there was no discharge of matter. The ligature was completely encysted, and the cyst had adhesions to the neighbouring parts. The nerve above the ligature was enlarged to some distance; below, it was much smaller than natural. The communication between each portion of the nerve was completely intercepted, except by the cyst.

After the nerve of the left leg was tied, it was divided below the ligature. The inferior portion was separated from the superior to some distance, and the space was filled with the coagulable lymph that formed the cyst of

the ligature: in every other respect the appearances in this leg corresponded with that of the other.

EXPERIMENT XXI.

The sciatic nerves of both legs were tied on the twelfth of August with a thin ligature, and the rabbit was killed on the twenty-seventh of September.

In the left leg, in which the nerve was divided below the ligature immediately after it was tied, the ligature had been cast off, and the wound in the skin and muscles was perfectly healed. The extremities of the nerve were separated nine-and-one-third-twelfths of an inch, and no attempt at union seemed to have begun. Parts of the toes had mortified and come off, as had also part of the heel.

In the right leg, in which the nerve was tied and not divided, the ligature had separated, and the portions of nerve had united: the place where the union had taken place was much smaller than when a nerve had been divided with a knife and allowed to heal. The foot was not in the least ulcerated, but looked as well as before the experiment.

EXPERIMENT XXII.

The sciatic nerve of the right leg of the same rabbit, as in the eighteenth experiment, was tied with a ligature of thread on the seventh of August, and it was killed, as before stated, on the twenty-second of November, the ligature having been drawn out on the thirtieth of August.

The portions of nerve between the ligatures were completely united. At the place where the ligature was fixed the superior portion was enlarged; below this the nerve was smaller, but appeared perfectly united to the superior portion, and like nerve. The skin about the os calcis was ulcerated, and part of that bone was dead; but the animal had improved in the use of the limb, though it was by no means perfect.

I have been astonished soon after making experiments on the sciatic nerves of rabbits, to see how much they use the limbs. As this is a point which is apt to deceive, I think it proper to notice it. It is from the nervous influence not being cut off from the large muscles of the thigh, that the animal is enabled to

make so much use of the limb: if it is observed during this time, it will be found that it always comes with a dead weight on the heel, and never on the toes; but when a nerve has been divided, and a sufficient length of time has elapsed for its reunion, the animal first goes occasionally on the toes, and as the powers of the nerve are restored, does so constantly.

CHAP. XV.

CONCLUSION.

It will be seen from these experiments, in the first place, that after a division of a nerve, the extremities of the divided portions become enlarged and more vascular, but especially the upper portion; and coagulable lymph, having the appearance of white of egg, is effused, which soon becomes vascular. In a few days the coagulable lymph from each portion becomes united, and anastomoses from between the blood-vessels; the coagulable lymph gradually assumes a firmer texture, and the number of the blood-vessels diminishes, and the newly-formed substance appears to contract, like all other cicatrices, so as to bring the extremities of the divided portions nearer and nearer to each other. It is difficult to determine from an experiment on the limb of an animal the exact time at which the nerve again performs its functions. In eight weeks after

the division of the sciatic nerve, I have observed a rabbit to be in some degree improved in the use of its leg, but at the end of eighteen weeks it was not perfect. When the nerves of the leg of a horse have been divided just above the foot, they are sufficiently restored to perform their functions in a very great degree in six or eight weeks; but it must be observed that these nerves are only formed for sensation, and it is very different with the nerves of voluntary motion.

What I have above stated is the usual way in which a divided nerve reunites; but it will be seen from one of the experiments, that the reunion is sometimes accomplished by granulations.

Secondly, I would observe, that punctures and partial divisions of nerves heal in the same way as when there has been a total division; and that, even on the first infliction of the wounds, the functions of the nerve are very little impaired.

Thirdly, It appears from the foregoing experiments, that when a portion of a nerve has been removed, the restorative process is set up in the same way as when there has been merely a division of the nerve; but the extremities of the divided portions afterwards pre-

sent such appearances, as to lead to a supposition that the nerve will never again be restored of the same size it was before. From the repeated experiments I have made, I had been led almost to conclude that a certain portion of a nerve is never restored after its removal, so as to be able to perform its functions; but that this is not always the case, the following circumstance will prove.

A horse had been lame for two years, at the end of which time an inch of each nerve going to the foot was cut out; after this he went very well for six months, when he again became lame, and continued so five months; at the end of this time he appeared to suffer such dreadful pain that he was killed. At the time he was operated on, it was supposed that the disease was the same in both fore legs, so that portions of the nerves of both of them were removed.

On examining the legs after he was killed, one was very much swelled, especially at the foot, where matter was discharged by several sinuses leading to the coffin bone, which was quite carious.

On further examination, the nerves of this leg were found to have reunited, and the new-formed substance was very large, and appeared

to have the same strueture as that which forms the bond of union when a nerve has been simply divided. The nerves, above the place where they were divided, were found to be mueh larger than those of the opposite leg in the same place. In the opposite leg, in which there did not appear to be mueh disease, the nerves had reunited, but the bond of union was not so large as in the other leg.

From these circumstanees, it appears to me that the funetions of the nerves were again performed, through the medium of the new-formed substanee; but I am informed this is not usually the ease when so large a portion as an inch of the nerve has been removed; and this eircumstanee shews, that in this instanee it must have been owing to the irritation occasioned by the disease in the foot.

So mueh depends on the subjeet, and a variety of eircumstances, that it is impossible to make any aceurate experiments to ascertain how large a portion of a nerve ean be restored after its removal. If this could be done, it would tend much to improve the treatment of diseases of the nerves, as we then might remove as large a portion of a nerve as would be neeessary to prevent the recurrence of a very painful eomplaint; or, knowing how far

a limb would suffer a permanent injury from the removal of a portion of a certain size, as in the case of a tumour being seated in it, we might at once determine, whether amputation of the limb would not be the best resource, when the patient is suffering so much as to lead to a supposition, that if he is not relieved, death must be the consequence.

It appears to me that a reproduction of a portion of a nerve is not accomplished without the greatest difficulty, except where there are very frequent communications with other nerves, or except a much increased action of the blood-vessels exists in consequence of a diseased state of the part in which the nerve is situated, as in the case related by Mr. Abernethy, where a portion of one of the digital nerves was removed. When a portion of a nerve has been removed, if its reproduction were a desirable object, this circumstance of its growth in diseased limbs makes it probable that it might be much assisted by irritating frictions, electricity, &c.

Though when a large portion of a nerve has been removed it is seldom restored, yet in some instances new nerves are formed to keep up a communication with the brain. In the eighteenth experiment I observed this for the

first time. These new nerves had not that almost transparent appearance that the bond of union has, but were white, and exactly like nerves. I have given a drawing of them, and of the nerves of a sound limb, that they may be compared with each other. It appears extraordinary that entirely new nerves should be formed, but it is not more so than that new arteries should be produced, as Dr. Parry has, I think, satisfactorily demonstrated.

Fourthly, I would observe, as another result from the experiments I have detailed, that when a ligature has been put on a nerve, the parts to which it is distributed are deprived of sensation and motion in the same manner as when a nerve has been divided. Immediately after its application, the vessels of the nerve begin to enlarge and become more numerous, and coagulable lymph is effused from each end of the nerve, which, in the nineteenth experiment, seventy-two hours after the application of the ligature, had united, and the vessels of each portion had anastomosed. The ligature becomes incased by the lymph. Immediately after it is cast off, the separated portions of nerve begin to unite, and the process of reparation goes on until the union is so complete as to enable it to perform its functions. Two in-

stances are related by Richerand*, where the nerves performed their functions after having been included in ligatures. He says, "by ways which are unknown, and in a manner which it is very difficult to explain, nature suffers ligatures to be put on the largest nerves without danger. It is thus that the median has been tied in the operation of aneurism without the hand, which was immediately benumbed, losing the sense of touch. I have seen also the foot, immovable after a ligature has been put on the internal portion of the popliteal nerve, to recover, by little and little, its movements."

When a ligature has been put on a nerve, the sooner it is cast off, the greater probability there is of a perfect restoration taking place. When it is known that a nerve has been tied, after a few days it will be better to pull the ligature gently every day to expedite its separation, as it may become so firmly confined to the parts about it by the coagulable lymph, as to make the reunion more difficult to be accomplished, when much time has elapsed before its separation; and so long as it remains it forms so complete a barrier as to prevent the reunion

* Nosographie Chirurgicale, tom. ii. p. 206.

of the separated portions, except in a very slight degree.

It happened in almost all the experiments I made, that where there was either a division of a nerve, or a portion of it had been removed, or it had been tied tight with a ligature, that the skin about the os calcis became in some degree ulcerated. Where care was not taken to keep the animals clean, and the hay which covered the bottoms of the boxes in which they were kept was suffered to be wet, part of the os calcis almost always became dead, and in some instances the toes mortified and fell completely off.

From the variety of experiments I have made in every way, and from the animals not suffering any of those violent symptoms sometimes attending injuries of the nerves in the human subject, I think we must conclude that something exists in the nerves thus affected different from what usually obtains in the animal economy; and as no change of structure is produced, as far as the eye can reach, the violent symptoms must be owing to a peculiar irritability superadded to them, either from a particular conformation of the body, or from such changes having taken place in the constitution, by disease, &c. as are known to produce

these effects on the brain and nervous system. I am here only speaking of the violent symptoms supervening on the wound of a nerve which has healed, and caused no change of structure to account for their production. I leave out of the question those injuries and diseases where there is a mechanical cause, as when a tumour or any extraneous matter is lodged in a nerve, and likewise where the nerves have become ulcerated, because I believe they are always productive of intense pain, let the state of the subject be what it will; though I think it probable that some constitutions suffer much more than others, even under such circumstances.

For the more satisfactory illustration of certain cases and experiments described in the preceding Dissertation, at the time it was delivered at the Royal College of Surgeons, it was accompanied with the under-mentioned wet preparations.

1. Ulcerated fibular nerve, from William Sharpe's leg.
2. Ulcerated anterior tibial nerve, from the same.
3. A portion of the sciatic nerve, from the

ham, suspended with a portion of the same nerve from a healthy limb, to shew the difference in point of size.

4. Portions of the peroneal nerve, to shew the same.
5. Portions of the posterior tibial nerve, to shew the same.
6. A portion of the inner plantar nerve, from William Sharpe's foot.
7. A portion of the same nerve, from the subject from which the nerves suspended with those from William Sharpe's leg were taken, to shew that this nerve is larger than the corresponding one from William Sharpe's leg; and to shew that the difference of size of the other nerves does not depend on their original formation, but on the change produced by disease.
8. A partial division of the dog's sciatic nerve healed, or rather that portion which forms the popliteal nerve, which will be seen towards the bottom of the preparation.
9. The tumour connected with the cutaneous nerve in Mrs. H.'s case.
10. A complete division of the dog's sciatic nerve healing by granulations.

11. To shew the regeneration of the nerve in the soundest leg of the horse.
12. To shew the same in the opposite leg, where there was a disease of the coffin bone.
13. To shew the origins of the cervical nerves, and the accessory nerve from the medulla spinalis, and the communications between each anterior and posterior fasciculus before the formation of the ganglia.

THE END.

Drawn by E. West

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Fig. 1

Fig. 2

Fig. 3

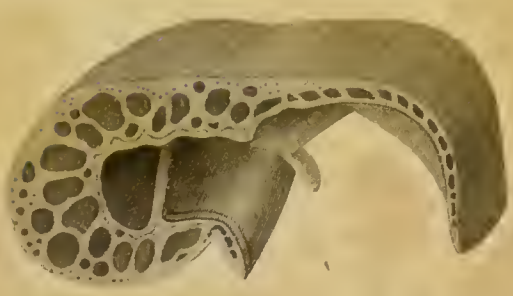

Fig. 4

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EXPLANATION OF THE PLATES.

Plate I.

Is an exact representation of a dry preparation made by the author for the Jacksonian Prize, preserved in the Museum at the Royal College of Surgeons. It is intended to shew the distributions of the nerves most affected by tic douloureux.

Plate II.

Was taken from a preparation of a rabbit's leg, which formed the subject of the eighteenth experiment, and shews the regeneration of nerve after a portion had been removed. This experiment has been twice repeated, and the results were the same.

Plate III.

Fig. 1.—Shews the Schneiderian membrane of the horse raised, and some of the sinuses, containing veins which are quite empty and contracted so as to have the appearance of solid chords.

Fig. 2.—Shews the veins and sinuses empty in a transverse section of one of the turbinated bones, with the Schneiderian membrane attached to it.

FIG. 3.—Shews the sinuses and veins distended with blood which had been coagulated by injecting a solution of oxymuriate of mercury by the carotid artery.

FIG. 4.—Shews the same as fig. 3, only that the coagulated blood has been removed.

To shew the extent to which the Schneiderian membrane may be distended, it is only necessary to introduce a blow-pipe into the vein that returns the blood from the inside of the nose and inflate it. This experiment can be made in the sheep. I have thus discovered, and in this plate I think satisfactorily exhibited, one of the most beautiful structures in the animal economy. I have now examined the nose in man, the horse, ox, and sheep, and in all of them find the peculiar structure for the distension of the Schneiderian membrane; and further than the uses stated in the note in pages 33 and 34, I would mention, that it is peculiarly calculated to resist the pressure of the atmosphere on the Schneiderian membrane, which otherwise would be so pressed against the bone to which it is attached, as to entirely prevent the nerves performing their functions.

A nearly similar structure to the nose exists in the soft palate.

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